NEXCEL
Nonmetallic Excellence and Innovation Center for Building Materials
非金属材料创新中心

CNBM | CBMA aramco 沙特阿美

NEXCEL ANNUAL REPORT 2025

MAR 2026

PERFORMANCE 2022-2025

NEXCEL Projects



36 Completed

6 Ongoing

14 Under final evaluation

Project Funding (Million CNY)

16 NEXCEL Fund



9.28 Parallel Fund

Project Outcomes

46 Patents	112 Papers	42 Demonstrations
20 Standards	15 Products	6 Technologies

80 Deployments

1505+ Tons Polymer Use

10650 Tons CO_2 ↓

Advocacy

34 Conferences & Forums	58 Conference Speeches
2M+ Views Mainstream Media Release	500K+ Views NEXCEL Media Release

Partnership

86 Project Partners	11 Project Sponsors
7 Strategic Partners	90 Outreach Visits

NEXCEL PROJECTS IMPACT



Polymer Use



NM Deployment



	Polymer Use	NM Deployment	CO_2
Fibers, Rebars, and Fiber Composites (FRPs)	177	41	350
Pavement for Roads & Bridges	435	17	6815
Special Mortars & Concrete	6.6	4	n/a
Construction Chemicals	206	10	385
Waterproofing & Repair Materials	480	4	n/a
Insulation & Composite Cladding	201	4	3100
Total	1505.6	80	10650

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INTRODUCTION

ABOUT NEXCEL

VISION

Transform the building and construction sector to non-metallic based materials to improve sustainability, asset lifecycle and lower carbon footprint.

MISSION

Expand and accelerate non-metallic technology deployment in the building and construction sector by developing and advocating non-metallic products, establishing and transforming non-metallic material standards and regulations, fostering effective non-metallic material awareness and training for the building and construction community.

ABOUT NEXCEL

Non-metallic Excellence and Innovation Center for Building Materials (NEXCEL) is jointly established by Aramco, the world's largest producer of energy and chemical products, together with China National Building Material Group (CNBM), the world's largest building materials manufacturer and services provider, and China Building Materials Academy (CBMA), the largest comprehensive scientific research institution for building materials in China. Aramco as the founding sponsor of NEXCEL and CBMA as NEXCEL’ s operator are working together to accelerate non-metallic technology deployment in the building and construction sector, and deploy innovative non-metallic technologies to provide more sustainable construction solutions.

MESSAGE FROM NEXCEL



STEERING COMMITTEE CHAIRMAN

Prof. ZHI Xiao

CHINA BUILDING MATERIALS ACADEMY

The global building materials industry is advancing towards greater sustainability, resilience, and intelligence. In this context, the second term of NEXCEL 2025-2028 reaffirms the shared commitment of Aramco and CBMA to leading this technical transformation through innovation in non-metallic materials.

During the first term 2022-2025, we are pleased to witness the significant progress and fruitful outcomes achieved by NEXCEL in meeting its vision and mission. Looking ahead, we will focus on integrating emerging technologies such as artificial intelligence with advanced non-metallic materials to provide smarter, more adaptive infrastructure solutions. Through deeper cross-sector collaboration, we are positioned to deliver transformative outcomes for a more resilient and sustainable future.



STEERING COMMITTEE MEMBER

Eng. SALEH Alwehaiby

Aramco

NEXCEL plays an integral role in accelerating the adoption of nonmetallic materials across the building and construction sector while fostering ecosystem growth. Through collaborations with industry partners, NEXCEL continues to push boundaries and advance material innovation, enabling more durable, sustainable, and efficient infrastructure. NEXCEL has become a driving force in reshaping the building landscape with nonmetallic materials, and has achieved excellence, driven by dedication and technical thoroughness. Moving forward and building on its collective achievements, NEXCEL will continue its momentum by driving innovation and leveraging advanced technologies including AI and digital solutions to further advance sustainable building materials development.

MESSAGE FROM NEXCEL



TECHNICAL ADVISORY COMMITTEE CHAIRMAN

Prof. HOU Diyang

CHINA BUILDING MATERIALS ACADEMY

Over the past four years, NEXCEL has funded **56** projects, leading to the outcomes of **15** products and **6** advanced technologies. These innovations have been adopted in **80** engineering projects across key infrastructure sectors — including marine engineering, pavements, bridges, and telecommunications — demonstrating their reliability and supporting large-scale deployment. By consistently integrating R&D with real-world demonstrations, NEXCEL is accelerating the transition of nonmetallic materials into a core component of sustainable infrastructure.

As TAC Chairman, I extend my sincere gratitude to all TAC members for their dedicated guidance, technical expertise, and active contributions throughout the project lifecycle. Looking ahead, we will continue to collaborate closely to ensure that NEXCEL's research remains relevant, robust, and ready for global impact.



NEXCEL ROGRAM DIRECTOR

Dr. LI Juan

CHINA BUILDING MATERIALS ACADEMY

By bringing together a technical committee of renowned specialists and a wide range of interdisciplinary project teams, NEXCEL has established itself as a premier hub for innovation. NEXCEL has so far generated impactful outputs spanning publications, patents, standards, and real-world deployments. Notably, these deployments to date have collectively contributed to a reduction of carbon emissions on the order of tens of thousands of tons.

To amplify our impact and extend the reach of these innovations, NEXCEL continues to strengthen its efforts in advocacy, standardization, and cross-sector collaboration. Through hosting international forums, participating in key industry events, and expanding partnership, we are working to raise awareness of materials transition to non-metallic solutions and foster broader adoption across the global construction ecosystem.

WIN-WIN COOPERATION

aramco 沙特阿美

One of the world's largest integrated energy and chemicals companies

Non-metallic Strategy

New Materials Strategy

CNBM

The world's largest building materials manufacturer and services provider

CNBM | CBMA

The largest scientific research institution for building materials in China

NEXCEL



To build a promising future with non-metallic materials

FOUR CORE FUNCTIONS

Technology Development

技术创新

Standards & Specifications

标准引领



宣传培训

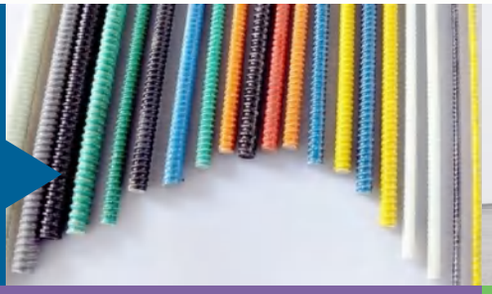
Advocacy & Training

产业应用驱动

Application & Acceleration

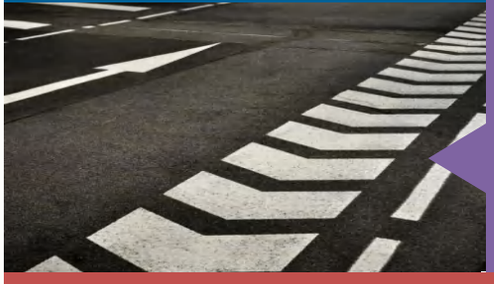
SIX FOCUSED AREAS

Fibers, Rebars, and Fiber Composites (FRPs)





Special Mortars & Concrete



Pavement for Roads & Bridges

Construction Chemicals



Waterproofing & Repair Materials





Insulation & Composite Cladding

1st STEERING COMMITTEE

(2022-2023)

CNBM | CBMA



MA Zhenzhu

President
China Building Materials Academy



HOU Diyang

CEO
China Building Materials Academy



WANG Hua

Director of Science and Technology
China Building Materials Academy

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Al-Otaibi, Waleed

Director
Aramco
Steering Committee Chairman



Al-Qahtani, Mohammed

Manager
Aramco



Shiban, Riyadh

Manager
Aramco

2nd STEERING COMMITTEE

(2024-2025)

CNBM | CBMA



ZHI Xiao

President

China Building Materials Academy

Steering Committee Chairman



HOU Diyang

CEO

China Building Materials Academy



QIU Yan

Director of Science and Technology

China Building Materials Academy

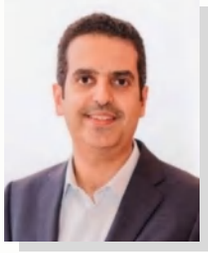
aramco



Al-Otaibi, Waleed

Director

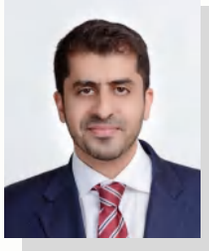
Aramco



Al-Qahtani, Mohammed

Manager

Aramco



Albinali, Hussain

Manager

Aramco

3rd STEERING COMMITTEE

(2026-2027)

CNBM | CBMA

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ZHI Xiao

President
China Building Materials Academy

LI Guijin

Director of Science & Technology
China Building Materials Academy



ZHOU Chunying

Assistant Director of Science & Technology
China Building Materials Academy



Alwehaiby, Saleh

Manager
Aramco
Steering Committee Chairman



Mehthel, Hamad S

Manager
Aramco



Allowemi, Saad

Vice President
Aramco Asia

TECHNICAL ADVISORY COMMITTEE (TAC)

TAC TASK FORCE



HOU Diyang

CEO

China Building Materials Academy

TAC Chairman



WANG Ling

Professor

China Building Materials Academy



XIAN Guijun

Professor

Harbin Institute of Technology



Mehthel, Mohammed

Principal Professional

Aramco



Salazar, Oscar

Engineering Consultant

Aramco



Abduljabbar, Sami

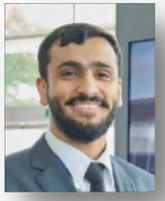
Engineering Specialist

Aramco

TECHNICAL ADVISORY COMMITTEE (TAC)



Al Musaiid, Ahmad
Sr. Engineer
Aramco



Aldakhil, Dakhel
Engineer
Aramco



FENG Peng
Professor
Tsinghua University



HUANG Songchang
Deputy Chief Engineer
Research Institute of Highway Ministry of Transport



KE Te
Lead Engineer
Aramco Asia



KONG Xiangming
Professor
Tsinghua University



LI, Victor C.
Professor
University of Michigan



QI Ligang
Chief Engineer
China Construction Eighth Engineering Division



Selim, Mohamed
Lead Engineer
Aramco



SUN Shibing
Professor
Beijing University of Technology



SUN Zhenping
Professor
Tongji University



WEN Zhaijun
Vice President
China Building Materials Academy



XU Shifa
Professor
Beijing University of Civil Engineering and Architecture



XUE Weichen
Professor
Tongji University



YANG Xiaoping
Professor
Beijing University of Chemical Technology



YANG Xiaoyu
Professor
Wuhan University of Technology



ZHANG Yong
Chief Engineer
China National Building Waterproof Association

(Alphabetical order by surname)

UNIVERSITY

PROJECT PARTNERS

INDUSTRY

PROJECT SPONSORS

中国建筑材料科学研究总院
中建材中岩科技有限公司
CNBM Zhongyan Technology Co., Ltd.

CKS 科顺

CCTC 中国建科 中国建筑标准设计研究院有限公司
CHINA INSTITUTE OF BUILDING STANDARD DESIGN & RESEARCH

安珈新材料
AEGA ADVANCED MATERIALS

WANHUA

ctc 国检集团

北京秦天科技集团有限公司
Beijing Qin Tian Science&Technology Group Co., LTD.

沪誉 HUYUJIANKE

江苏恒美德新材料有限公司
Jiangsu Chemlead New Material Co., Ltd.

CEEC 中国能建 ENERGY CHINA
CGGC
葛洲坝集团交通投资有限公司
GEZHOUBA GROUP TRANSPORTATION INVESTMENT CO., LTD.

哈尔滨玻璃钢研究院有限公司
Harbin FRP Institute Co.,Ltd.

STRATIGIC PARTNERS

CCPA 中国混凝土与水泥制品协会
China Concrete & Cement-based Products Association

CIEEMA 中国绝热节能材料协会
China Insulation & Energy Efficiency Materials Association

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

中国复合材料学会
CHINESE SOCIETY FOR COMPOSITE MATERIALS

China National Building
Waterproof Association

International Union of Laboratories and
Experts in Construction Materials,
Systems and Structures

TRUONG DAI HOC XAY DUNG HA NOI
Hanoi University of Civil Engineering

02

PERFORMANCE

PERFORMANCE 2025

56 NEXCEL Projects



Project Outcomes

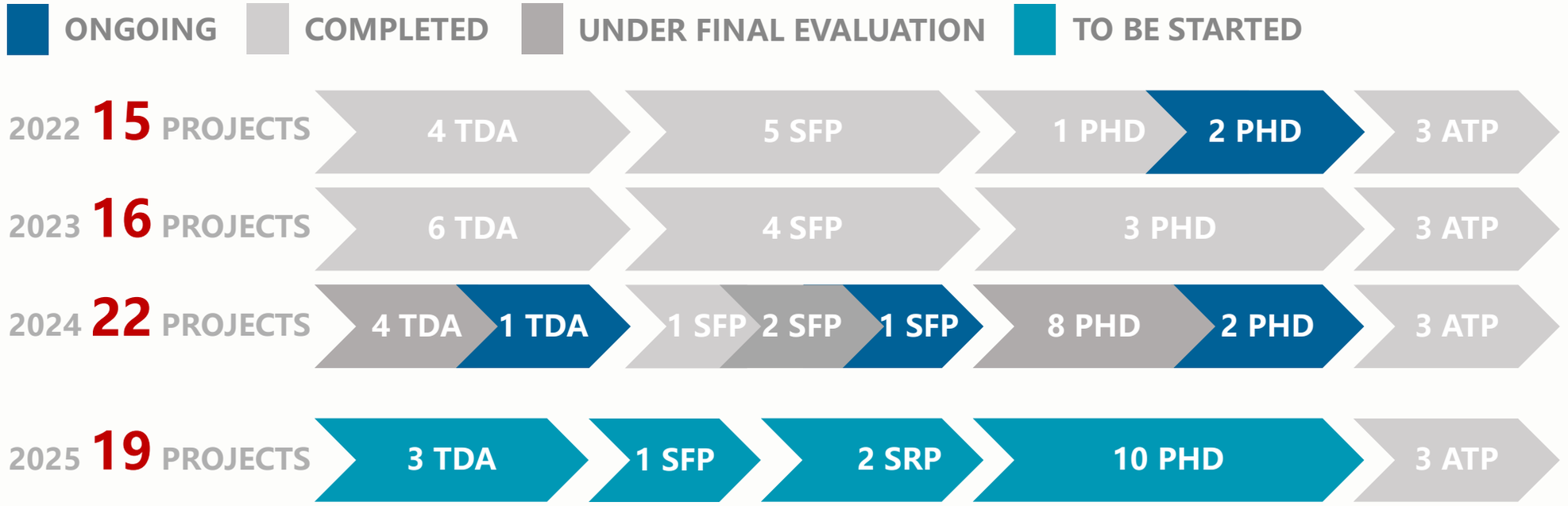
7 Patents	48 Papers	10 Standards
7 Products	1 Technology	14 Demonstrations

Advocacy

2 Conferences	6 Forums
26 Conference Speeches	90 WeChat Articles
1,000,000+ Views Mainstream Media Release	250,000+ Views NEXCEL Media Release

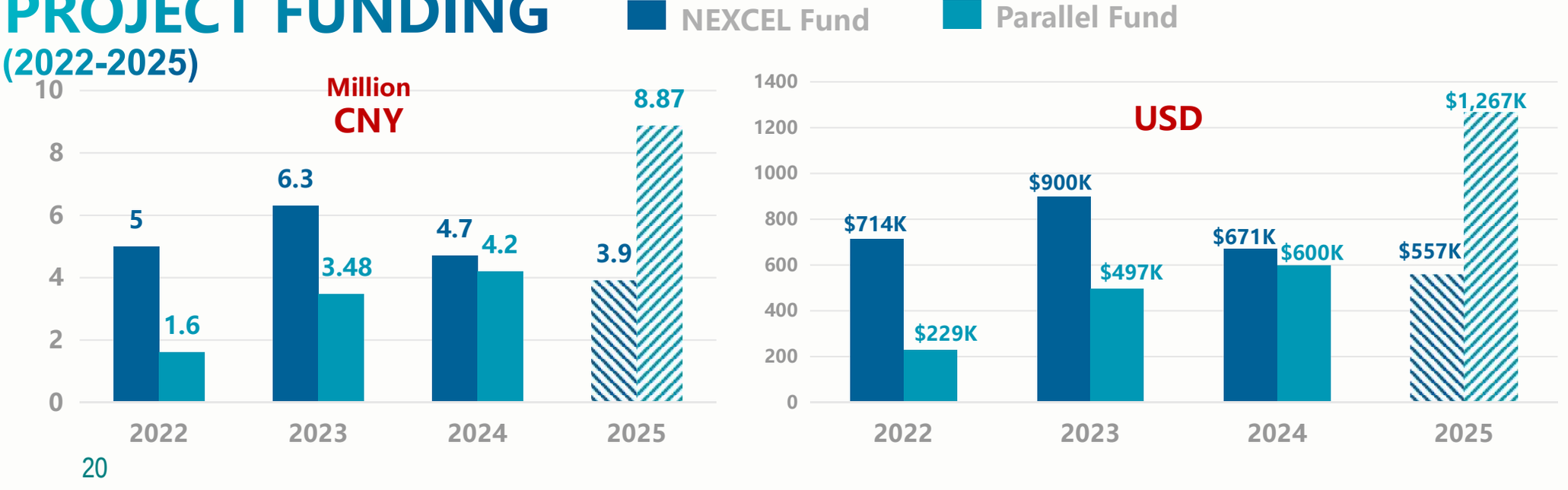
PROJECT PROGRESS

(2022-2025)



PROJECT FUNDING

(2022-2025)



PROJECT CATEGORY



Technology Development and Acceleration Project (18 TDA)

4 Projects/2022
6 Projects/2023
5 Projects/2024
3 Projects/2025

Duration: 2 Years



Small Fund Project

(14 SFP)

5 Projects/2022
4 Projects/2023
4 Projects/2024
1 Project /2025

Duration: 1-1.5 Years



Standard and Regulation Project (2 SRP)

2 Projects/2025

Duration: 1-2 Years



Ph.D. Scholarship Project (26 PHD)

3 Projects/2022
3 Projects/2023
10 Projects/2024
10 Projects/2025

Duration: 2 Years



Advocacy or Training Project (12 ATP)

3 Projects/2022
3 Projects/2023
3 Projects/2024
3 Projects/2025

Duration: 1 Year

PROJECT PORTFOLIO

		2022	START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA1-1	Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members	JUL 2022	JUN 2024	**100%**	Completed
2	TDA2-4	Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration	JUL 2022	JUN 2024		
3	TDA3-1	Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer	JUL 2022	DEC 2024		
4	TDA4-1	Development and demonstration of composite lattice tower for communication and power transmission over 15m	JUL 2022	JUN 2024		
SFP PROJECTS						
5	SFP1-1	Research on 3D printed polymer modified concrete and its interface enhancement technology	JUL 2022	JUN 2023	**100%**	Completed
6	SFP2-1	Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil	JUL 2022	JUN 2023		
7	SFP3-1	Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement	JUL 2022	JUN 2023		
8	SFP4-1	Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel	JUL 2022	JUN 2023		
9	SFP5-1	Study on key technology of polymer modified inferior coarse aggregate	JUL 2022	JUN 2023		
PHD PROJECTS						
10	PHD-1	High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components	JUL 2022	JUN 2026	**90%**	**Extended**
11	PHD-2	Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate	JUL 2022	JUN 2024	**100%**	Completed
12	PHD-3	Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials	JUL 2022	JUN 2026	**90%**	**Extended**
ATP PROJECTS						
13	ATP-1	The 10th ISCC parallel session on petroleum-based building materials	JUL 2022	DEC 2022	**100%**	Completed
14	ATP-2	Advocacy activities for the application of petroleum-based concrete admixture in low-carbon concrete	JUL 2022	DEC 2022		
15	ATP-3	2022 NEXCEL series of forum	JUL 2022	DEC 2022		

PROJECT PORTFOLIO

2023			START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA1-1	Develop hydrocarbon-based graphene for improving properties of concrete	JAN 2023	JUN 2025	**100%**	Completed
2	TDA2-2	Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life	JAN 2023	JUN 2025		
3	TDA3-2	Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings	JAN 2023	JUN 2025		
4	TDA4-1	Preparation and application of FRP bent bar under corrosive environment	JAN 2023	JUN 2025		
5	TDA5-1	Fire endurance and creep resistance improvement for application of GFRP rebars	JAN 2023	JUN 2025		
6	TDA6-2	Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete	JAN 2023	JUN 2025		
SFP PROJECTS						
7	SFP1-2	Effects of recycled plastics on the performance of asphalt mixture	JAN 2023	JUN 2024	**100%**	Completed
8	SFP2-1	Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars	JAN 2023	JUN 2024		
9	SFP3-2	Standardization and demonstration of preparing building formwork with waste plastics	JAN 2023	JUN 2024		
10	SFP4-1	Development of self-healing fire-retardant coatings highly compatible with non-metallic surfaces	JAN 2023	JUN 2024		
PHD PROJECTS						
11	PHD-1	CFRP prestressed concrete assembled raft-type floating structures	JAN 2023	DEC 2024	**100%**	Completed
12	PHD-6	Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials	JAN 2023	DEC 2024		
13	PHD-8	Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites	JAN 2023	DEC 2024		
ATP PROJECTS						
14	ATP-1	Session on composite materials in civil engineering at China composites conference	JAN 2023	DEC 2023	**100%**	Completed
15	ATP-2	International conference and forum on waterproofing & repair materials	JAN 2023	DEC 2023		
16	ATP-3	2023 NEXCEL series of forum	JAN 2023	DEC 2023		

PROJECT PORTFOLIO

	2024		START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA-1	Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure	JAN 2024	JAN 2026	**100%**	Under final evaluation
2	TDA-2	Development and demonstration of polymer aerogel composites	JAN 2024	JAN 2026	**100%**	Under final evaluation
3	TDA-3	Development and demonstration of non-metallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement	JAN 2024	JUN 2026	**70%**	**Extended**
4	TDA-4	Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life	JAN 2024	JAN 2026	**100%**	Under final evaluation
5	TDA-5	Develop certification for external thermal insulation composite systems (ETICS)	JAN 2024	JAN 2026	**100%**	Under final evaluation
SFP PROJECTS						
6	SFP-2	Application and demonstration of FRP tube-concrete new composite structure	JAN 2024	JAN 2026	**100%**	Under final evaluation
7	SFP-3	Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture	JAN 2024	JAN 2026	**100%**	Completed
8	SFP-4	Research and demonstration on the performance of thermoplastic FRP stirrup	JAN 2024	JUN 2025	**100%**	Under final evaluation
9	SFP-5	Application and demonstration of hydrocarbon-based graphene in asphalt mixture	JAN 2024	JUN 2026	**90%**	**Extended**
ATP PROJECTS						
10	ATP-1	The conference on high-quality development of concrete and cement products	JAN 2024	DEC 2024	**100%**	Completed
11	ATP-2	International conference on building materials 2024 (ICBM2024)	JAN 2024	DEC 2024		
12	ATP-3	2024 NEXCEL series of forum	JAN 2024	DEC 2024		

PROJECT PORTFOLIO

		2024	START DATE	END DATE	PROGRESS	MILESTONE
		PHD PROJECTS				
13	PHD-1	Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement	JAN 2024	JAN 2026	**100%**	Under final evaluation
14	PHD-2	Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt	JAN 2024	JAN 2026	**100%**	Under final evaluation
15	PHD-3	Surface modification of extruded polystyrene foam and the study of its flame retardancy and adhesion performances	JAN 2024	JAN 2026	**100%**	Under final evaluation
16	PHD-4	Synthesis of phosphorus-containing metalimidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin	JAN 2024	JAN 2026	**100%**	Under final evaluation
17	PHD-5	Study on multifunctional carbon fabric reinforced seawater and sea sand concrete composite component system	JAN 2024	JAN 2026	**100%**	Under final evaluation
18	PHD-6	Ultimate and serviceability limit state design for FRP-UHPC hybrid beams	JAN 2024	JAN 2026	**100%**	Under final evaluation
19	PHD-7	Preparation and performance of self-healing polymer modified asphalt waterproofing membrane	JAN 2024	JAN 2026	**100%**	Under final evaluation
20	PHD-8	Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization	JAN 2024	DEC 2026	**75%**	**Extended**
21	PHD-9	Preparation of railway sleeper using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties	JAN 2024	JUN 2026	**75%**	**Extended**
22	PHD-10	Preparation and mechanism of carbon black/cement based electromagnetic wave absorbing materials with multimechanism	JAN 2024	JAN 2026	**100%**	Under final evaluation

PROJECT PORTFOLIO

	2025		START DATE	MILESTONE
TDA PROJECTS				
1	TDA-1	Development of long-term performance monitoring technology for FRP rebars in pre-stressed concrete	APR 2026	To be started
2	TDA-2	Research and demonstration of efficient and low-cost exterior wall thermal insulating systems for existing buildings	APR 2026	
3	TDA-3	Development and demonstration of FRP height limit protection device	APR 2026	
SFP PROJECT				
5	SFP-1	Research on seismic performance and ductility improvement of FRP reinforced concrete prefabricated components	APR 2026	To be started
SRP PROJECTS				
6	SRP-1	Research, demonstration and standardization of FRP curtain wall	APR 2026	To be started
7	SRP-2	Investigation on the standardization status of FRP composites for civil engineering	APR 2026	
ATP PROJECTS				
8	ATP-1	Special Session in 79th RILEM Annual Week	OCT 2025	Completed
9	ATP-2	Participation in 19th MECC	OCT 2025	
10	ATP-3	2025 NEXCEL series of forum	OCT 2025	

PROJECT PORTFOLIO

		2025	START DATE	MILESTONE
PHD PROJECTS				
11	PHD-1	Investigation of the durability and anchorage properties of CFRP rods for offshore mooring lines	APR 2026	To be started
12	PHD-2	Fiber-reinforced seawater sea-sand geopolymer composites for marine engineering environments: preparation, crack resistance and durability	APR 2026	
13	PHD-3	Multi-objective performance prediction and intelligent design of engineered cementitious composites (ECC): a materials genome perspective	APR 2026	
14	PHD-4	Mechanical properties of regolith bag components for lunar construction	APR 2026	
15	PHD-5	Design of self-compacting rubberized concrete through rubber-matrix interface enhancement and steel fiber reinforcement	APR 2026	
16	PHD-6	Vibration attenuation characteristics and optimal design of locally resonant metaconcrete	APR 2026	
17	PHD-7	Capacity enhancement of disintegration-oxidation and performance regulation of recycled rubber-polyethylene modified asphalt	APR 2026	
18	PHD-8	Research on the water damage mechanism of polyurethane mixture	APR 2026	
19	PHD-9	Performance and mechanism investigation of SBS modified asphalt rejuvenated with devulcanized rubber/bio-oil composite rejuvenator	APR 2026	
20	PHD-10	Magnetically driven epoxy resin crack repair technology and multi scale performance study	APR 2026	

PROJECT OUTCOMES 2025

Papers

48



Patents

7



Standards

10



Demonstrations

14



7

Products

1

Technology



PRODUCTS & TECHNOLOGY 2025

- Glass-Fiber-Reinforced Plastic (GFRP) Connectors
- Glass-Fiber-Reinforced Plastic (GFRP) Stirrups
- Hydrocarbon-Based Graphene
- Thermoplastic Polyolefin (TPO) Waterproofing Membrane
- Polyisocyanurate (PIR) Insulation Material
- Phase Change Energy Storage Particles
- Phase Change Energy Storage Asphalt Mixture
- Performance Enhancement Technology for GFRP Rebar

PAPERS

No.	Project No.	Paper Name
1	23TDA3-2	*Calculation method for heat transfer coefficient of ribbed composite insulated exterior wall panels*
2		*Experimental research on shearing behavior of connectors in precast sandwich insulation wall panel*
3		*Experimental research on anchoring performance of connectors in precast sandwich insulation wall panel*
4		*Finite element analysis of stress performance of precast concrete multi-ribbed sandwich insulation facade panel*
5	23TDA5-1	*Experimental investigation on post-fire mechanical properties of glass fiber-reinforced polymer rebars*
6		*Static and fatigue behavior of CFRP strengthened spiral welded steel tubes subjected to four-point bending*
7		*Novel adaptive prestressed CFRP-reinforced steel column: Concept and behavior*
8		*Novel high-temperature resistant GFRP bars with DOPO-modified vinyl ester: Design, performance, and application*
9		*Long-term Behavior of High Performance GFRP Bars, International Conference on Advances in Engineering and Technology for sustainable development*
10		*High-temperature mechanical properties of GFRP bars Experimental database and novel degradation models*
11	23TDA6-2	*Mechanical performance of polymer-modified mortar with the newly designed gradient structure: effect of polymer types and content*
12		*Research progress on concrete-polymer composites*
13		*The influence of gradient change in polymer content on the properties of cement mortar*
14		*Research on gradient-enhanced polymer-modified concrete for structural use and comparison with conventional concrete*
15		*A new method to improve the crack resistance of cement-based composites: Development of magneto-responsive polymer latex and performance evaluation*
16	24TDA-1	*Effects of aggregates and fibers on the strength and permeability of concrete exposed to low vacuum environment*
17		*Hydration and microstructure evolution of cement paste in low vacuum environments*
18		*Regulating drying shrinkage behavior of cement-based materials in low vacuum environments and developing a predictive model*
19		*Acoustic emission-based flexural fracture analysis of polyethylene fiber reinforced ultra-high performance concrete under low vacuum environment*
20		*Enhancing Concrete Performance in Low Vacuum Environments: Strategies and Mechanisms*
21	24TDA-2	*Hydrophobic Phenolic/Silica Aerogel Composites with High Fire Safety and Strength for Efficient Thermal Insulation*
22		*Recent Advances in Inorganic Hybrid Phenolic Aerogels*
23	24TDA-4	*Preparation of waterborne polyurethane-modified trackless emulsified asphalt and its road performance*
24		*Degradation mechanism and performance of polyurethane mixture under water conditions*
25		*Study on the road performance and development mechanism of polyurethane binder in different media solutions*

No.	Project No.	Paper Name
26	24TDA-5	*External thermal insulation composite systems (ETICS) supplier and its certification method*
27		*Research on the influencing factors of the compatibility index of the exterior insulation system (ETICS) of the thin plastered exterior wall*
28	24SFP-2	*Seismic behavior of full-scale PEN FRP-concrete-steel double skin tubular columns*
29		*Seismic performance and shear strength of HECC/RC beam-column joints with simplified reinforcement*
30		*Seismic performance of short concrete columns reinforced with steel-FRP composite bars and GFRP stirrups*
31		*Seismic Performance of Embedded GFRP Tube-Concrete Composite Exterior Beam-Column Joints*
32	24SFP-3	*A practical method for testing the properties of phase change materials and composites*
33	24SFP-4	*Effect of fiber surface treatment with silane coupling agents and carbon nanotubes on mechanical properties of carbon fiber reinforced nylon 6 composites*
34		*Study on the durability of compression behavior for glass fiber-reinforced polypropylene thermoplastic composite bars in various aging environments*
35	24SFP-5	*Investigation on physical, rheological properties and VOCs emission of asphalt modified with hydrocarbon-based graphene*
36	24PHD-1	*Maintenance mechanisms of rejuvenator-optimized asphalt emulsion in damaged porous asphalt mixture: Morphological, physicochemical, and rheological characterizations*
37	24PHD-2	*Investigating the role of sulfur stabilizer in modulating aging properties of SBS-modified asphalt*
38		*Evolution of Phase Structure and Mechanical Properties in Aged SBS-Modified Asphalt*
39	24PHD-3	*Recycling of wind turbine blade powder into HDPE wood-plastic composites: Enhanced mechanical and flame-retardant properties via interfacial modification*
40		*Self-assembled coatings with durable flame retardancy for EPS foam*
41	24PHD-4	*Phosphorus-derived imidazolium salts with varied oxidation states: Tailoring latency, mechanical properties, and flame retardancy in single-component epoxy resins*
42	24PHD-6	*Effect of shear connection degree on static behavior of externally prestressed FRP-concrete hybrid beams: Experimental and numerical study*
43	24PHD-7	*Development of sustainable desulfurized waste crumb rubber modified asphalt with enhanced self-healing properties*
44		*Effect of aging on structure and properties of self-healing-enhanced SBS modified asphalt with dual dynamic chemical bonds*
45		*Effect of dynamic disulfide bonds on microstructure, storage stability, and self-healing performance of desulfurized waste crumb rubber–modified asphalt*
46	24PHD-8	*Recent advances in monomer-in-situ polymerization modified cement-based materials*
47	24PHD-10	*Design of microwave absorbing frequency bands and selection criteria for vitreous aggregates in cement-based materials*
48		*Effects of Coal Gas Fine Ash on Electromagnetic Properties of Cement Mortar and Carbon Black Modification*

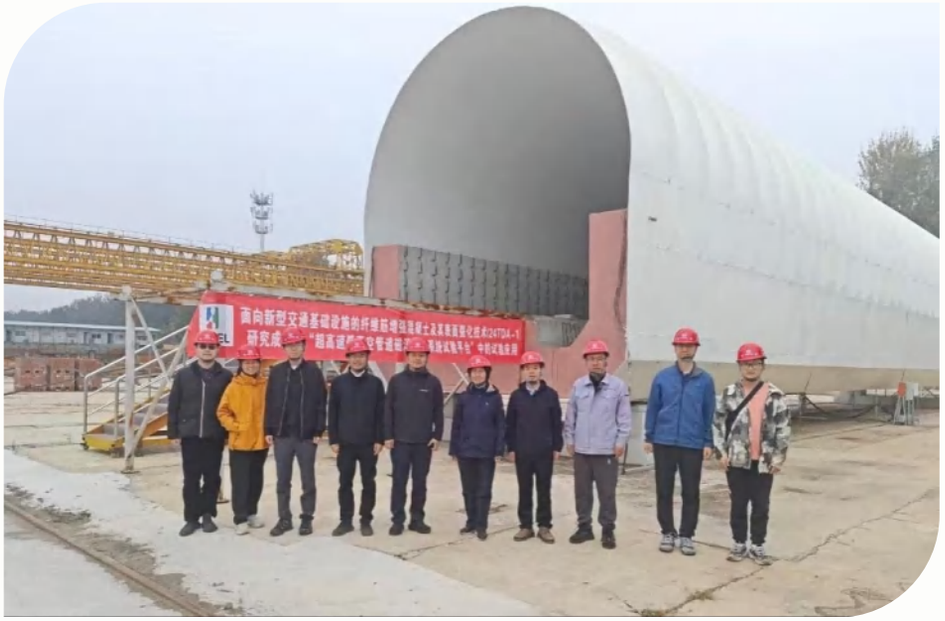
PATENTS

No.	Project No.	Status	Patent Name
1	24TDA-1	Filed	An epoxy resin-based composite coating, coating layer, and preparation method adapted for low-vacuum environments
2	24TDA-2	Filed	A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method, application
3	24TDA-4	Filed	A modeling method of molecular dynamics model for a kind of road single-component polyurethane adhesive
4	24SFP-2	Granted	A beam-column joint reinforced with FRP tubes
5	24SFP-2	Granted	A novel composite structure of FRP tubes and concrete
6	24SFP-3	Granted	A method and device for testing the thermal performance of plate-like phase change energy storage components
7	24SFP-5	Filed	A kind of mixing and stirring device

STANDARDS

No.	Project No.	Status	Standard Name
1	22TDA1-1	Issued (T/CSTM 01346-2025)	Test method for tensile properties for pultruded fiber reinforced polymer composites — End-pushing clamp method
2	22TDA3-1	Draft for Approval	Polyether and its derivatives for concrete admixtures
3	23TDA1-1	Draft for Review	Graphene for cement and concrete
4	23TDA3-2	Issued (GB/T 46826-2025)	Technical requirements for integrated load-bearing and insulation wall panels and connecting accessories in low-rise and mid-rise rural housing
5	23TDA3-2	Draft for Review	Technical specification for connectors in precast concrete non-composite insulated sandwich wall panels
6	23TDA4-1	Draft for Review	Fiber reinforced polymer stirrups
7	23TDA6-2	Draft for Review	Technical specification for polymer modified concrete pavement application
8	24TDA-4	Issued (T/CSTM 01345-2024)	Specifications for design of polyurethane mixture for road
9	24SFP-2	Draft for Review	Technical guidelines for composite RC joint structures with FRP (fiber-reinforced polymer)-tubed concrete core columns
10	24TDA-5	Draft for Approval	Requirements of certification for external thermal insulation composite systems

DEMONSTRATIONS



Fiber-reinforced special concrete for low vacuum pipelines applied in the "Ultra-high-speed low-vacuum pipeline maglev transportation system test platform" in Pinggu, Beijing

- 3.5% redispersible polymer latex powder
- 0.6% (by volume) UHMWPE fiber
- Dust ↓ 75%
- 100% replacing low magnetic steel bars by GFRP Bars



Phase change material applied to Meitai Highway in Shaanxi

- 38 km
- 76 tons PCM
- CO_2 ↓ 28.5 tons/year



The polyurethane pavement applied in the urban road project in Jinan

- 11.5 km PU pavement
- 604 tons PU
- 60 tons adhesive between layers
- CO_2 ↓72.8% CO↓88.2% SO2↓97.0%



Gradient reinforced polymer modified concrete applied to Anyang-Hebi Highway

- 4% magnetic phenylbenzene emulsion
- Enhanced mechanical properties
- Improved durability of concrete

DEMONSTRATIONS

GFRP rebars in coastal retaining wall in waterfront area of barka, Oman

- 4.8 km wall
- 35 tons GFRP rebars
- 45 tons GFRP stirrups





GFRP Rebars-concrete fence in sea dam renovation project, Lianyungang

- 120 tons GFRP spiral stirrups
- CO_2 ↓ 40%

Thermoplastic composite bar reinforced concrete prefabricated beams in Dayangshan offshore base project

- 1080 linear meters
- CO_2 ↓ 70%





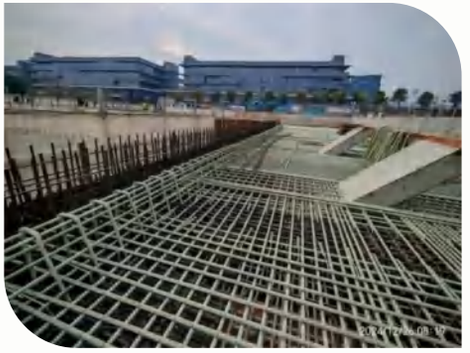
High-performance GFRP bars in coastal industrial construction

- 9100 linear meters
- CO_2 ↓ 17%
- Cost ↓ 19%

Thermoplastic FRP rebars in Fuzhou Port

- 231 linear meters
- CO_2 ↓ 70%
- Cost ↓ 23.8%





GFRP rebars in experimental pool, Jiangsu

- 30.21 tons GFRP rebars
- CO_2 ↓ 40%

DEMONSTRATIONS

FRP tube-concrete composite joint structure in Beijing Lize demonstration project

- Construction efficiency ↑ 50%
- Cost ↓ 32%



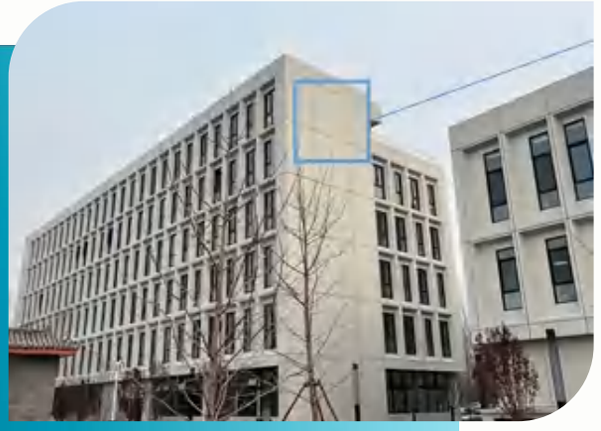


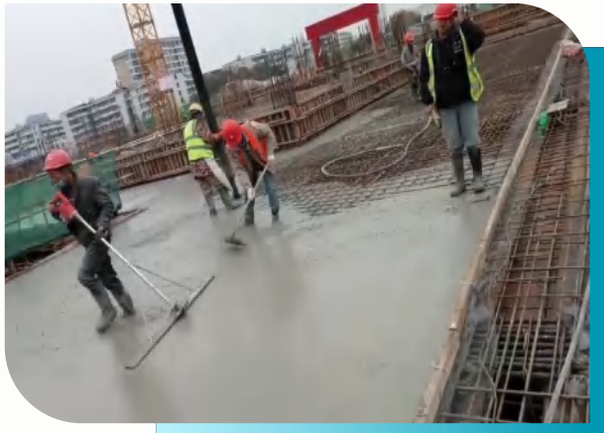
Polymer-based aerogel composites in building insulation project, Nanjing

- 648 kg polymer aerogel composites
- CO_2 ↓ 1.42 tons/year

FRP connectors and PIR insulation material in ultra-low energy buildings, Beijing

- Energy efficiency ↑ 50.69%
- CO_2 ↓ 22 tons/year



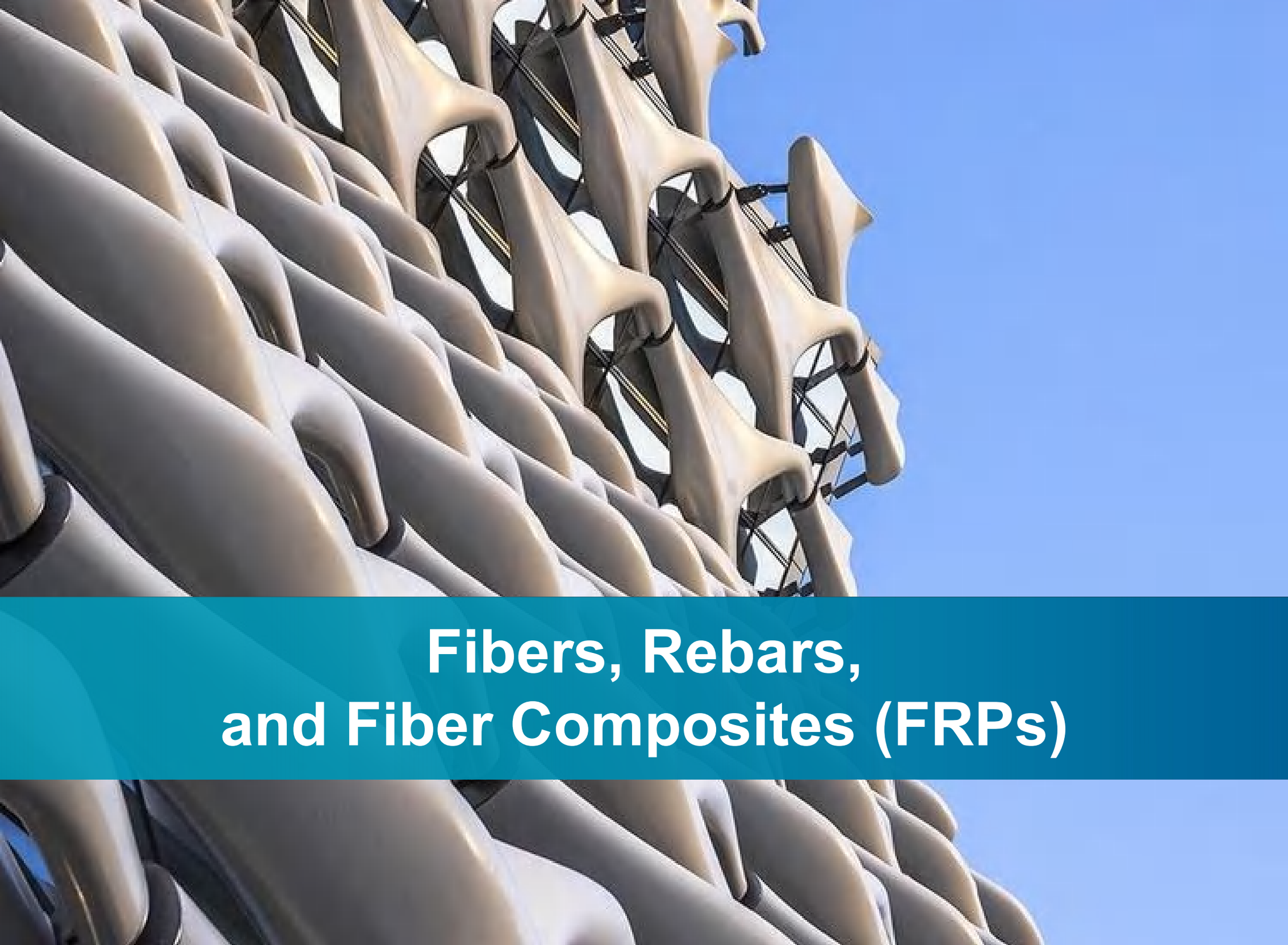


Graphene concrete in renovation project of hazardous building, Wuhan

- 0.03%~0.06% graphene in concrete
- 900 m^3 graphene concrete

03

PROJECT AREAS



Fibers, Rebars, and Fiber Composites (FRPs)

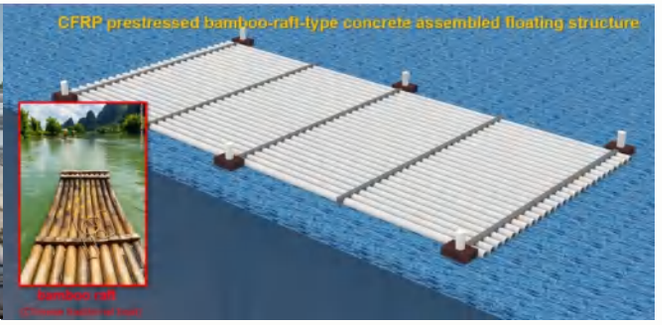
Projects on Fibers, Rebars & Fiber Composites (FRPs)

1	22 TDA1-1	Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members
2	22 TDA4-1	Development and demonstration of composite lattice tower for communication and power transmission over 15m
3	22 PHD-1	High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components
4	23 TDA4-1	Preparation and application of FRP bent bar under corrosive environment
5	23 TDA5-1	Fire endurance and creep resistance improvement for application of GFRP rebars
6	23 SFP2-1	Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars
7	23 PHD-1	CFRP prestressed concrete assembled raft-type floating structures
8	23 PHD-8	Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites
9	24 TDA-1	Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure
10	24 SFP-2	Application and demonstration of FRP tube-concrete novel composite structure
11	24 SFP-4	Research and demonstration on thermoplastic FRP stirrup
12	24 PHD-4	Synthesis of phosphorus-containing metalimidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin
13	24 PHD-5	Study on multifunctional carbon fabric reinforced seawater and sea sand concrete composite component system
14	24 PHD-6	Ultimate and serviceability limit state design for FRP-UHPC hybrid beams









Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2022 TDA1-1
(JUL 2022 - JUN 2024)

Project Name: Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members

BACKGROUND

Fiber reinforced polymer (FRP) composites, owing to their advantages of lightweight, high strength and stiffness-to-weight ratios, excellent corrosion resistance and superior fatigue performance, have shown great potential in civil engineering. Nonetheless, due to low modulus of elasticity, lack of robust connection method, significant brittle sudden failure mode, poor fire resistance, and uncertainty in creep performance, FRPs have not been universally-accepted in practice. This is manifested by the facts that the civil engineers tending to adopt FRPs do not have full confidence in the material, and those engineers who have the confidence in material do not have sufficient skills of designing with FRPs.

AIMS AND GOALS

- To propose 1 or 2 FRP joint nodes with pultrusion process;
- To develop fiber composite rebar with good ultimate tensile strain and post yield strain;
- To develop composite profiles with high in-plane shear strength and equivalent tensile strength;
- To enhance the overall performance of composite structural parts with high efficiency of material strength and high ductility factor at the ultimate state;
- To reach fire rate grade B1 and fire resistance limit of the horizontal load-carrying parts ≥1 h;
- To develop design methods for highly-ductile composite structure parts.



PI: Prof. LIU Tianqiao

PROJECT TEAM

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

SPARE 南京斯贝尔复合材料仪征有限公司

中国矿业大学(北京) CHINA UNIVERSITY OF MINING AND TECHNOLOGY-BEIJING

INNOVATIONS

- Developed a novel type of anchorage system of corrugated anchor for prestressed CFRP plates. This system is composed of corrugated steel plates and high-strength bolt fastenings.
- Improved the anchorage efficiency by using the thicker anchor plate with epoxy adhesive, and the optimum anchor configuration was found to be 30 mm thick anchor plate with epoxy adhesive together with 150 N · m retightening torque, and the nominal ultimate tensile strength of the CFRP plate reached 2100 MPa.

3 PATENTS

- A type of anchor for gripping CFRP plate
- A fire-resistant and flame-retardant pultruded fiber reinforced composite and its manufacturing method
- A fire-retardant pultruded fiber reinforced composite profile

1 STANDARD

- Standard test method for tensile properties of pultruded fiber reinforced polymer composites - using a dual-tapered specimen

5 PAPERS

- *Flexural performance of curved-pultruded GFRP arch beams subjected to varying boundary conditions*
- *Analysis-oriented model for FRP tube-confined concrete: 3D interpretation of biaxial tube behaviour*
- *Strengthening RC beams with mid-span supporting prestressed CFRP plates: an experimental investigation*
- *Application of ultra-lightweight and large-scale pultruded for external frame beam in high-rise buildings*
- *A binary resin system of epoxy and phenol-formaldehyde for improving the thermo-mechanical behavior of FRP composites*

1 DEMONSTRATION

- Pultruded GFRP external frame beam for high-rise building in Qingdao



IMPACT

This project tackled with typical problems encountered in applications of pultruded FRP composites. The research findings directly permit a breakthrough of the technological bottleneck of pultruded FRP composites. In particular,one demonstration project is conducted, and one design guide is established, which are to showcase the advantages and clarify the mechanics of pultruded FRP composites and their structures, and finally, to remove those concerns existing in the field and to promote pultruded FRP composites in the future.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2022 TDA 4-1
(JUL 2022 - JUN 2024)

Project Name: Development and demonstration of composite lattice tower for communication and power transmission over 15m

BACKGROUND

Traditional communication and power grid steel tower have the problems of difficult transportation and high transportation cost in remote mountainous areas, and composite material due to its excellent comprehensive performance, such as high strength, light weight, corrosion resistance, good insulation and other characteristics, is used in communication and power industry in various countries. In special working conditions, composite lattice tower is a useful supplement to the existing communication and transmission tower.

AIMS AND GOALS

- To optimize the fiber and matrix materials for lattice towers, and reduce the total mass of lattice tower by ≥25% compared with metal one;
- To study composite lattice tower structures design, and reduce the use of metal connectors in lattice tower;
- To decrease single-piece mass of composite tower components, and enhance the connection strength.

PROJECT TEAM

哈尔滨玻璃钢研究院有限公司
Harbin FRP Institute Co.,Ltd.



PI: Prof. SUN Yunlong



INNOVATIONS

- GFRP materials with fiber volume content 68% were prepared by an injection pultrusion process using ECR9600-T911 glass fiber, isocyanate BM20 and polyether polyol urepul 2140P polyurethane resin as raw materials, with the tensile strength 1200 MPa, bending strength 1400 MPa, compressive strength 1000 MPa.

- The transverse tensile strength of composite lattice tower main beam and power transmission produced by pultrusion with full multi-axial cloth is more than 5 times higher than that produced by traditional pultrusion, the transverse bending strength is more than 6 times higher.

- Based on the analysis of the structural form and performance of composite joints, the composite structure with tenon-mortise structure and bolt fastening is designed, which is 10 times higher than the failure load of adhesive joints, the failure load is 2 times higher than that of bolt connection. Greatly improve the overall stability of the lattice tower.

- By using mechanical-free installation technology, the total installation period can be reduced from 7 to 5 days. The transportation and installation cost is reduced by 12.5% compared with that of the metal tower.

2 DEMONSTRATIONS

- FRP composite lattice tower built in Egypt and Guangzhou, China

2 PAPERS

- *Comparative study on wind load design of communication lattice tower standard between Chinese, American and European*
- *Improving performance of GFRP joints using bolted/mortise-tenon hybrid method*

1 STANDARD

- Specification for manufacturing of composite lattice towers for communication'

1 PATENT

- A washboard corner composite profile, forming tooling and preparation method





IMPACT

As a substitution for steel, GFRP lattice tower avoids up to 35% CO_2 emission. Global demand of 5G facilities are soaring, GFRP promises substantial life-cycle carbon emission in telecommunication infrastructure. As the light weight, high strength and excellent weather resistance, GFRP composite products have greatly reduced the transportation and installation cost as well as the inspection and maintenance cost.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 90%

2022 PHD-1
(JUL 2022 - JUN 2026)

Project Name: High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components

BACKGROUND

Fiber reinforced polymer (FRP) materials, with light-weight, high strength, corrosion resistance, and superior uni-directional mechanical properties along the fiber direction can effectively solve the problem of corrosion in civil engineering. However, the disadvantage of low modulus (only 70-75GPa) of the glass fiber reinforced polymers (GFRPs) produced from conventional glass fibers is prominent, and their modulus will further decrease with increasing temperature. How to solve this problem has become particularly important.

AIMS AND GOALS

- To obtain the structural origin of the Elinvar effect in oxide glasses, and realize the controllable preparation of high-modulus oxide glasses with Elinvar effect and glass fibers;
- To dope SiO_2, TiO_2 or graphene into epoxy resin to achieve its toughening modification;
- To prepare the high-modulus GFRP with Elinvar effect by compounding the produced glass fibers and modified epoxy resin;
- To realize the integrated design of members and joints in truss structures of GFRP through optimized the connection efficiency of the components.

PI: Prof. TAO Haizheng
PhD student:
ZHOU Hemin



武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY

INNOVATIONS

- The effects of nano-SiO_2 and graphene content on the mechanical and thermal properties of epoxy resin were systematically studied, including tensile modulus, elongation at break, coefficient of thermal expansion, thermal conductivity, and the optimal content was determined.
- The combined incorporation of kaolin and graphite into GFRP reduced the loss of room temperature flexural strength and increased the high-temperature residual flexural strength by over 100%.

1 PAPER

Pubulished in Ceramics International (SCI Q1)


Ceramics International 50 (2024) 33325–33332

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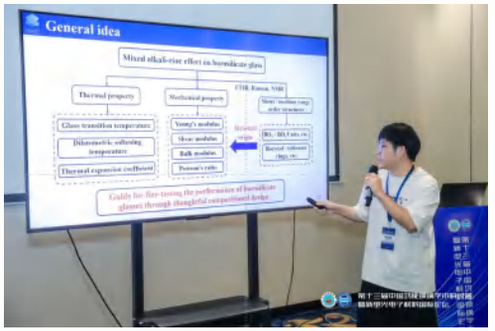
Impacts of substitution of alkali by zinc on thermo-mechanical properties in borosilicate glasses

Hemin Zhou [a,1], Guanzhou Xiao [a,1], Qingshuang Zheng [a], Ang Qiao [a,b], Haizheng Tao [a,*]

[a] State Key Laboratory of Silicate Materials for Architectures, Wuhan University of Technology, Wuhan, 430070, China
[b] Wuhan University of Technology Advanced Engineering Technology Research Institute of Zhongshan City, Zhongshan, 528437, China

2 CONFERENCE PRESENTATIONS

- The 13th China Functional Glass Academic Symposium and New Optoelectronic Materials International Forum
- The 22nd International Symposium on Non-Oxide and New Optical Glasses





IMPACT

From the perspective of the mechanical properties, thermal properties, and curing yield of the modified epoxy resin, it is difficult to meet the multiple performance requirements with a single nanoparticle modification.

Incorporating inorganic fillers is an effective method to improve the high-temperature residual strength of GFRP. This finding is crucial for enhancing the high-temperature resistance of GFRP and can effectively broaden its usable temperature range.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2023 TDA4-1
(JAN 2023 - JUN 2025)

Project Name: Preparation and application of FRP bent bar under corrosive environment

BACKGROUND

Corrosion of steel reinforcements in concrete structures that are explored to aggressive environments is one of the major factors that can render a structure structurally deficient before reaching the design service life. One alternative solution is the substitution of steel with fiber-reinforced polymer (FRP) bars. However, standardized, large-scale manufacture of three different types of stirrups (end-lap, closed and spiral stirrups) has not yet been well established. The mechanical behavior of stirrups and the shear/torsion failure mechanism of beams reinforced with FRP longitudinal bars and stirrups have not been investigated. Hence, further research is needed to provide technical support for the industrial production of FRP stirrups and their wide application in engineering structures.

PROJECT TEAM

同济大學 TONGJI UNIVERSITY

湖南大學 HUNAN UNIVERSITY

江苏恒美德新材料有限公司 Jiangsu Chemlead New Material Co., Ltd.



PI: Prof. JIANG Jiafei

AIMS AND GOALS

- To develop 3 configuration-improved FRP stirrups, with the cost- effective and good mechanical performance;
- To establish the bend strength models for 3 stirrups considering creep fracture effect;
- To develop shear and shear-torsion design methods for FRP reinforced concrete members.





INNOVATIONS

- Developed the manufacturing technology for the end-lap stirrups, spiral stirrups, and closed stirrups.
- Propose the distribution model of bend strength retention rate for FRP stirrups, and the design value corresponding to specific guarantee rate.
- Conduct the creep test for FRP stirrups, and proposed calculation method for the creep strength and predicted creep rupture stress limit.
- Conduct shear tests on full-scale simply supported beams, and elucidated the contributions of shear-transfer mechanisms.
- Conduct torsion and torsion-shear tests on full-scale beams, revealed the torsional failure mechanism and reveal the shear-torsion interaction relationship.
- Conduct three demonstration projects including one oversea project, and extended the application to the laboratory structure for corrosion environment.

7 PAPERS

- *Shear behavior of two-span continuous concrete deep beams reinforced with GFRP bars*
- *Calculation approach for tensile strength of GFRP stirrup at bend based on database*
- *Strength retention rate distribution model and reliability analysis of FRP stirrups*
- *Transfer learning-based confinement strength prediction of concrete confined by FRP transverse reinforcements*
- *Flexural behavior and design of ultrahigh-performance concrete beams reinforced with GFRP bars*
- *Experimental investigation on pure torsion behavior of concrete beams reinforced with glass fiber-reinforced polymer bars*
- *A modified softened truss model and strength prediction formula for fiber-reinforced polymer reinforced concrete members under pure torsion*

1 STANDARD T/CECS "Fiber-Reinforced Polymer Stirrups"

1 PATENT A device and process for producing FRP stirrups

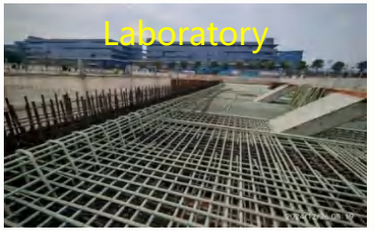
4 DEMONSTRATIONS

- Dinh An Port Terminal Project in Vietnaml
- Phase II Project of Seawall Restoration in Guanxi Section, Guanyun County (Concrete fence board)
- A Pool Test Workshop Project in Jiangsu
- Coastal Retaining Wall Project in the Waterfront Area of Barka, Oman









IMPACT

- The solution of the key technology of FRP stirrup preparation forms a good industrial effect, which is conducive to promoting the standardised production and large-scale application of FRP, a green and low-carbon construction material (reducing 20% CO_2 emissions compared with steel).
- The proposed design method for FRP reinforced concrete beams provides technical support for the application of FRP stirrups in concrete structures and the draft of relevant design codes.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2023 TDA5-1
(JAN 2023 - JUN 2025)

Project Name: Fire endurance and creep resistance improvement for application of GFRP rebars

BACKGROUND

Glass fiber reinforced polymer (GFRP) has gained significant popularity in the domains of civil engineering, aerospace, and harbor engineering owing to its high specific strength, specific modulus, excellent corrosion and fatigue resistance, and low carbon emissions. However, despite these advantages, the application of GFRP bars in practical construction projects remains limited. This can be attributed to several factors, including the poor fire resistance of GFRP, incomplete investigation of its creep properties, and the limited availability of long-term design methods for GFRP reinforced concrete structures. It is imperative to address these challenges to promote the wider utilization of GFRP bars and associated structures.

AIMS AND GOALS

- To propose a novel technology for improving the fire resistance of GFRP reinforcement based on the degradation law of its tensile strength at high temperatures;
- To explore the degradation behavior of GFRP reinforced concrete components under fire conditions and establish a performance-based fire resistance design method;
- To propose a technology for improving the creep performance of GFRP based on the influence law of its creep fracture performance.

PROJECT TEAM

泰山玻璃纤维有限公司
Taishan Fiberglass Inc.

中复碳芯电缆科技有限公司
ZHONGFU CARBON CORE CABLE TECHNOLOGY CO., LTD



PI: Dr. HU Lili



DEMONSTRATION

- High-performance GFRP bars applied in coastal industrial construction



1 PATENT

- Preparation method of modified vinyl ester resin

5 PAPERS

- *Novel high-temperature resistant GFRP bars with DOPO-modified vinyl ester: Design, performance, and application, Case Studies in Construction Materials*
- *Experimental and numerical study on fire resistance of GFRP bar-reinforced concrete slabs, Journal of Building Structures (In Chinese)*
- *Experimental investigation on post-fire mechanical properties of glass fiber-reinforced polymer rebars. Polymers, 2023, 15(13): 2925.*
- *Long-term Behavior of High Performance GFRP Bars, International Conference on Advances in Engineering and Technology for sustainable development. 2025, Rilem.*
- *High-temperature mechanical propertiesof GFRP bars: Experimental database andnovel degradation models. Constructionand Building Materials 493, 143222, 2025*

INNOVATIONS

- Developed a modified vinyl ester resin with improved property by blending phosphorus and flame retardants. The modified resin is used as one of the material to manufacture GFRP rebar.
- The proposed GFRP rebar achieves and exceeds the target of 45% tensile strength retention at temperature 400℃, with 68%.
- In terms of fire resistance of GFRP RC member, clarified a general trend of thicker concrete protection layer can improve the fire resistance of structure. In addition, under the same volume, increasing the length of fire retardant (applied on edge of member) is more effective than increasing the thickness.

IMPACT

This project focuses on the development of a next-generation glass fiber-reinforced polymer (GFRP) bar, which boasts excellent mechanical properties, high-temperature resistance, superior creep resistance, and excellent corrosion resistance. Life cycle analysis indicates that GFRP bars reduce CO_2 emissions by at least 17% over their entire life cycle compared to conventional steel reinforcement. Beyond environmental benefits, GFRP bars also offer significant cost savings. The use of GFRP bars can result in initial cost savings of approximately 19-23%, with potential savings reaching up to 40% over the lifespan of the structure. This innovative material represents a sustainable and cost-effective solution for modern construction challenges.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2023 SFP 2-1
(JAN 2023 - JUN 2024)

Project Name: Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars



PI: Prof. XIAN Guijun

哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY

BACKGROUND

The lack of product standard or test method for continuous fiber reinforced thermoplastic resin based composite bars limits their industrial development and engineering applications. The preparation method, composition, performances and engineering application methods of thermoplastic rebars are quite different from those of thermosetting ones, and the existing standards for thermosetting bars cannot be directly used for thermoplastic ones. The standardization of thermoplastic rebars will be the key to promote their large-scale applications.

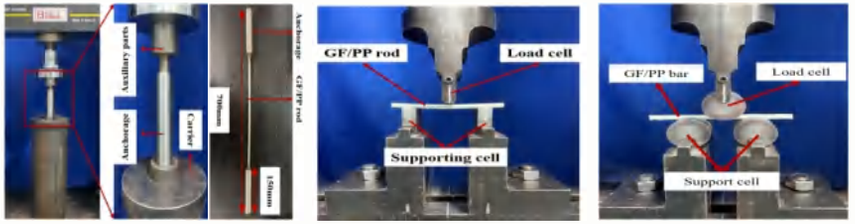
AIMS AND GOALS

- To formulate product or testing standards for thermoplastic rebars;
- To obtain physical mechanical and hot bending properties of thermoplastic rebars;
- To obtain basic performance indicators of thermoplastic rebars.



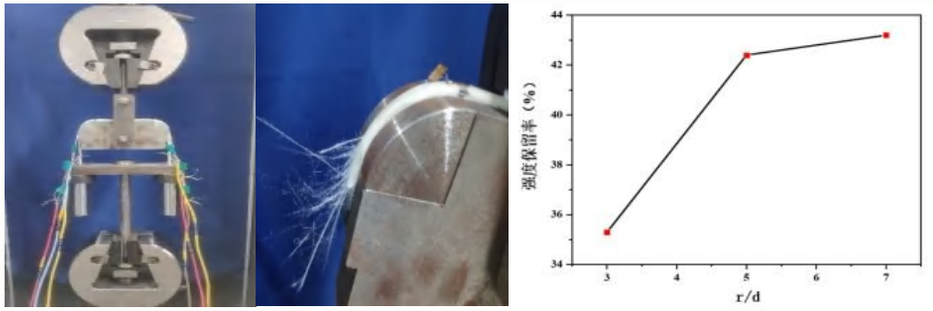
INNOVATIONS

- The physical and mechanical properties of three kinds of thermoplastic composite bar are obtained.
- Bending device of thermoplastic composite bar is developed, the test method and verification data of thermal-bending performance for thermoplastic composite bar are obtained.
- The standardization of continuous fiber reinforced thermoplastic composite products and testing methods has been carried out, and the standard of 'Thermoplastic Fiber-reinforced Polymer Composite Bars' has been published



Tests and performances of thermoplastic composite bar

Performances	GFRPP	CFRPA6	GFRPM
Tensile strength/MPa	887.2±36	2934±58	1233.4±16.1
Tensile modulus/GPa	34.8±0.6	142±2	58.9±1.5
Flexural strength/MPa	750±118	814±78	826.8±126.8
Flexural modulus/GPa	20±2.7	90.6±4.5	25.6±0.9
Shear strength/MPa	24.9±1.24	35.5±3.3	29.1±4.4



Thermal-bending property and verification data of thermoplastic composite bar

STANDARD: Thermoplastic Fiber-reinforced Polymer Composite Bars


团 体 标 准
热塑性纤维增强复合材料筋
Thermoplastic Fiber-reinforced Polymer Composite Bars
中国工程建设标准化协会 发布

"T/CECS 10424—2024 Thermoplastic Fiber-reinforced Polymer Composite Bars" is the first product standard for thermoplastic composite bars in China. This standard applies to continuous glass fiber reinforced thermoplastic resin-based composite bars using polypropylene, polyamide (nylon), and methacrylate resins for buildings, marine engineering, etc.

IMPACT

- The product standard of continuous fiber-reinforced thermoplastic polymer composite bars has been established, which can solve the problem of performance testing and evaluation of thermoplastic composite bars, and to fill the gap in China.
- The research results of project serves the major national strategic of engineering construction, which promotes the development of technical level and market application of thermoplastic composites bars in civil engineering.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED /100%

2023 PHD-1
(JAN 2023 - DEC 2024)

Project Name: CFRP prestressed concrete assembled raft-type floating structures

BACKGROUND

The construction of offshore structures used for energy development, fishery and tourism can expand the space and promote ocean economic development. The traditional way to transfer sea to land is land reclamation, but it causes huge damage for the local environment. Compared to onshore construction, offshore construction faces many disadvantages: harsh corrosion environment, complex loading condition, and limited maintenance capacity. Therefore it is necessary to develop new offshore structures with new materials, such as FRP composites.

AIMS AND GOALS

- To design a new concrete floating platform for the marine environment;
- To establish a prediction model for CFRP stress corrosion;
- To propose a design method for CFRP prestressed concrete assembled raft-type floating structures;
- To promote the use of petroleum-based materials in marine structure and large-scale offshore infrastructure construction.

清華大學 土木水利学院
SCHOOL OF CIVIL ENGINEERING
TSINGHUA UNIVERSITY



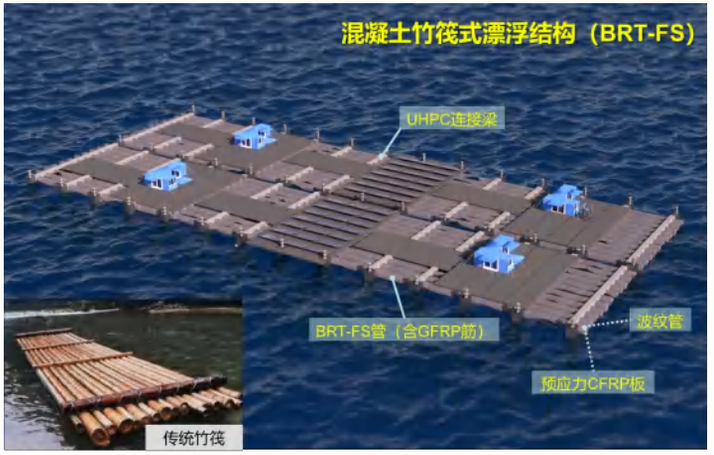
PI: Prof. FENG Peng



PhD Student: XIE Chongfeng

INNOVATIONS

- Inspired by bamboo rafts, a novel BRT-FS assembled by FRP reinforced concrete tubes is proposed, which has good designability and construction efficiency due to its unique structural design.
- The durability is improved by the addition of two corrosion-resistant materials, concrete and FRP. The bearing and buoyancy functions are separated to further increase the durability of the structure and ease structural design.



2 PAPERS

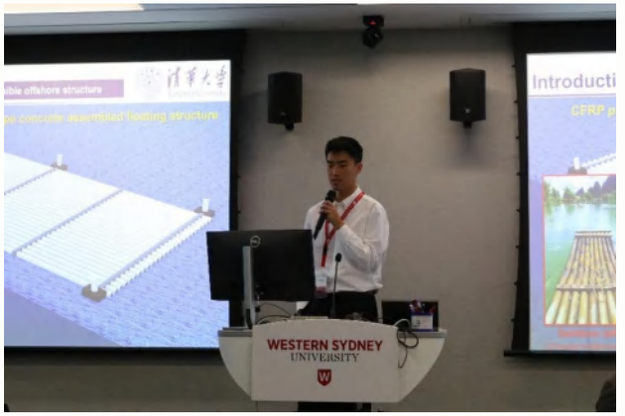
- *Novel bamboo-raft-type floating structure (BRT-FS) assembled by FRP reinforced concrete tubes: conceptual design and analysis*
- *Mesoscale simulation method for preplaced aggregate concrete based on physics engine*

1 PATENT

- Raft-type platform with photovoltaic and wave power generation system

1 CONFERENCE PRESENTATION

- The 4th International Symposium for Emerging Researchers in Composites for Infrastructure



IMPACT

The research results of stress corrosion of CFRP can be used to guide its application in harsh corrosion environment, improve the structural performance in extreme environment, and expand the market demand of CFRP. The concept design of bamboo raft floating structure can guide the construction of marine infrastructure, promote the economic development of coastal areas, and further promote the application of high-durability materials such as fiber reinforced polymer in marine engineering.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED /100%

2023 PHD-8
(JAN 2023 - DEC 2024)

Project Name: Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites

BACKGROUND

There are many bridges that have been in use for a long time and the bridge deck is one of the most frequently and critically damaged components. The severely damaged bridge deck must be replaced. Glass fiber reinforced polymer (GFRP) composite has the advantages of light weight, high strength, corrosion resistance, which can be used to replace the damaged bridge deck. However, creep significantly affects the micro-crack aggregation, interface fatigue failure and fiber fatigue fracture of GFRP material under fatigue loading, and the mechanism of fatigue-creep coupling is complex. The existing design methods have insufficient understanding of the fatigue-creep coupling mechanism of GFRP and lack of effective evaluation methods, which has become a bottleneck for the application of GFRP materials in bridge engineering.

AIMS AND GOALS

- To study the influence of creep on the fatigue performance of GFRP structure under high stress level and the influence mechanism of creep on the fatigue time-dependent performance of pultruded GFRP material;
- To establish an accurate and reliable multi-scale numerical simulation method for fatigue-creep coupling time-dependent performance of GFRP materials;
- To predict the evolution law of stiffness and creep deformation of bridge GFRP structure under complex load.

西安交通大学
XI'AN JIAOTONG UNIVERSITY

PI: Prof. XIN Haohui





Ph.D Student: GAO Qinlin

INNOVATIONS

- A series of prediction models were established to describe the fatigue life, energy dissipation capacity and cyclic creep strain.
- An analytical model was proposed to predict fatigue crack propagation in center cracked plate strengthened with FRP strip.
- The fatigue damage process and mechanism of the web-flange junction were deeply explored.

3 PAPERS

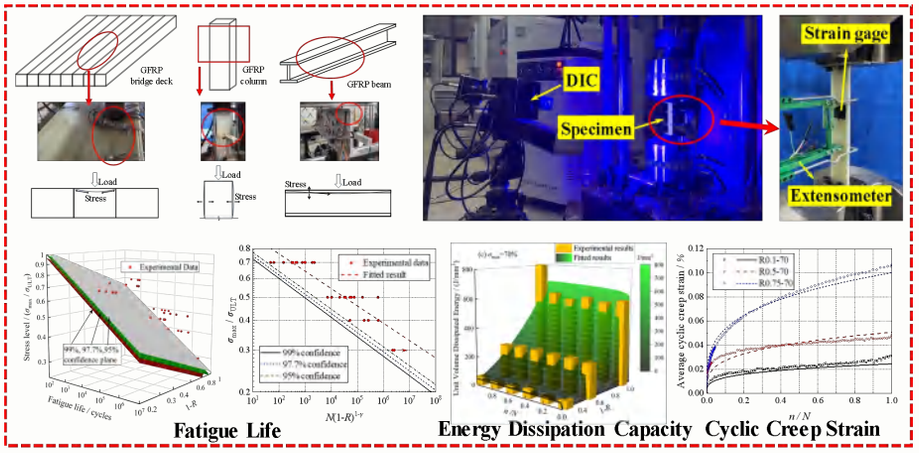
- *Experimental investigation on transverse tension-tension fatigue behavior of pultruded glass-fiber reinforced polymer (GFRP) unidirectional lamina*
- *Probabilistic fatigue stiffness variation of angle-ply GFRP composites considering stress ratio effect*
- *Prediction of fatigue crack propagation in center cracked steel plate strengthened with partially covered CFRP strip*

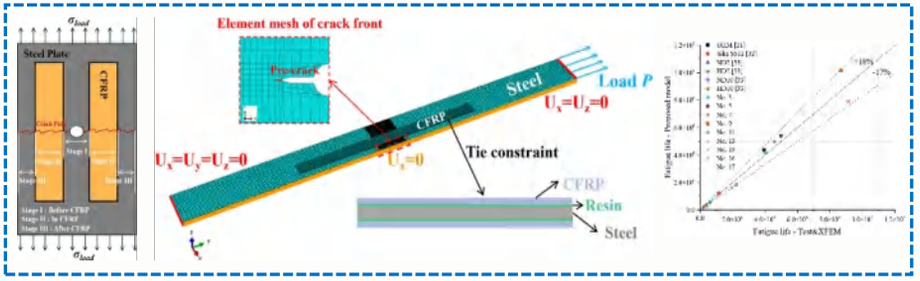
1 CONFERENCE PRESENTATION

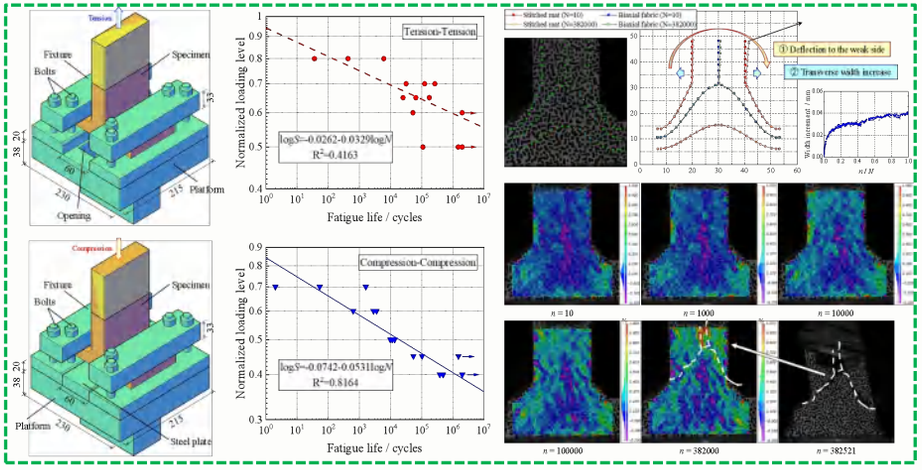
- “Research on axial fatigue behavior of web-flange junctions of pultruded GFRP profile” in ICCS26 & MECHCOMP8

IMPACT

Economically, it reduced costs by providing theoretical support for the rational design of GFRP structure durability, which can decrease expenses related to frequent maintenance and replacement of structures. Socially, its successful implementation can lead to more reliable infrastructure (such as bridges, buildings, and pipelines), improving public safety and well-being. In terms of carbon reduction, GFRP materials generally have a longer service life compared to some traditional construction materials.







Fibers, Rebars, and Fiber Composites (FRPs)

UNDER FINAL EVALUATION / 100%

2024 TDA-1
(JAN 2024 - DEC 2025)

Project Name: Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure

PI: Prof. LONG Guangcheng

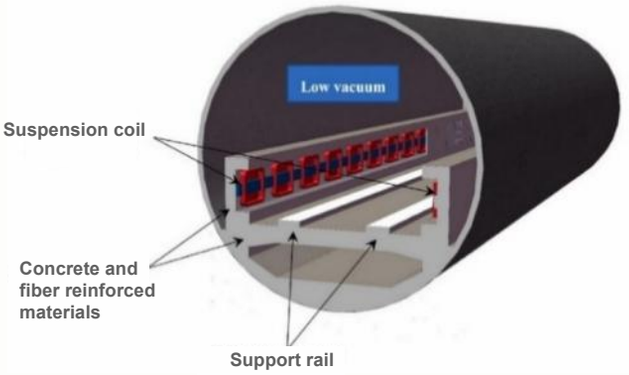


BACKGROUND

The low-vacuum magnetic levitation transport system operates in a challenging environment, where the concrete structure is exposed to low vacuum, pressure variations, and high temperatures. These factors present significant challenges to the long-term safety and performance of the system. Additionally, the issue of electromagnetic interference from steel reinforcement to the magnetic levitation system requires urgent resolution. It is necessary to develop high-performance special concrete and surface reinforcement technologies targeted for this system.

AIMS AND GOALS

- To understand the performance evolution mechanism of concrete, non-metallic fiber and coating materials suffering low-vacuum;
- To develop high performance special concrete by employing non-metallic petroleum-substrate fiber reinforcement system;
- To innovate high quality petroleum-substrate coatings for concrete surface reinforcement in new transport infrastructure such as ultra-high speed low vacuum pipeline system.



Low vacuum pipeline system

PROJECT TEAM

中南大學 CENTRAL SOUTH UNIVERSITY

中国中铁 中铁工程设计咨询集团有限公司 China Railway Engineering Design and Consulting Group Co.,Ltd.

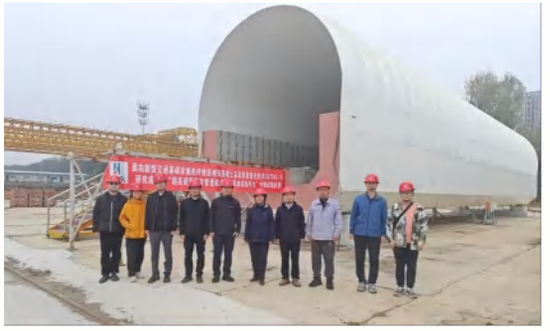


INNOVATIONS

- Propose a design and preparation method for low magnetic resistance, high toughness and high durability special concrete suitable for low vacuum pipeline structures.
- Simulates the service environment of low vacuum pipelines, reveal the influence patterns and mechanisms of low vacuum environments on concrete performance.
- Utilize hydrocarbon-based polymers, non-metallic fibers, and FRP toughening materials to improve the long-term service stability of concrete and reduce the magnetic resistance during train operations.
- Design a device to capture dust released in low vacuum environments, investigate the causes of dust release, and explore dust suppression measures.

IMPACT

- The durability and operational stability of low-vacuum pipeline structures can be greatly enhanced through fiber and FRP reinforcement techniques, providing critical material and technical support for the construction of new transportation infrastructure.
- The designed special concrete uses redispersible latex powder, modified emulsified asphalt, polyethylene fibers, and FRP, which not only enhance the performance of the concrete but also promote the high-value utilization of petroleum-based materials, and reduce CO_2 emissions.



DEMONSTRATION

Fiber-reinforced special concrete for low vacuum pipelines is applied in the "Ultra-high-speed low-vacuum pipeline maglev transportation system test platform" in Pinggu, Beijing

2 PATENTS

- A High-Stability Concrete for Low Vacuum Pipeline Environments and Its Preparation Method
- An epoxy resin-based composite coating, coating layer, and preparation method adapted for low-vacuum environments

8 PAPERS

- *Design and characterization of a low-magnetoresistance, high-stability concrete for ultra-high-speed low-vacuum tube infrastructure.*
- *Acoustic emission-based flexural fracture analysis of polyethylene fiber reinforced ultra-high performance concrete under low vacuum environment.*
- *Effects of aggregates and fibers on the strength and permeability of concrete exposed to low vacuum environment.*
- *Regulating drying shrinkage behavior of cement-based materials in low vacuum environments and developing a predictive model.*
- *Hydration and microstructure evolution of cement paste in low vacuum environments.*
- *Mechanical properties and damage analysis of polymer fiber reinforced concrete in low vacuum environments based on acoustic emission technology.*
- *Enhancing concrete performance in low vacuum environments: strategies and mechanisms.*
- *Effect of Vacuum Exposure on Mechanical Properties of Polymer-fiber Modified Concrete.*

Fibers, Rebars, and Fiber Composites (FRPs)

UNDER FINAL EVALUATION / 100%

2024 SFP-2
(JAN 2024 - DEC 2025)

Project Name: Application and demonstration of FRP tube - concrete new composite structure

BACKGROUND

In response to the issues of shear failure in the core area of traditional reinforced concrete frame joints and the difficulties in construction due to dense reinforcement in the joint area, this project proposes a new type of composite joint, namely the FRP tube-concrete combination joint. The construction of the new joint is more convenient, improving construction efficiency and facilitating the development of green and modular construction in joint structures.

PROJECT TEAM

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

CityU 香港城市大學 City University of Hong Kong

中国建筑第八工程局有限公司 CHINA CONSTRUCTION EIGHTH ENGINEERING DIVISION CORP., LTD

AIMS AND GOALS

- To establish design methods for the axial compression performance of FRP tube-concrete composite columns.
- To clarify the key construction and construction techniques of FRP tube-concrete composite joints and conduct engineering.
- To develop calculation methods for the shear capacity and seismic performance of FRP tube-concrete composite joints.



Prof. BAI Yulei

INNOVATIONS

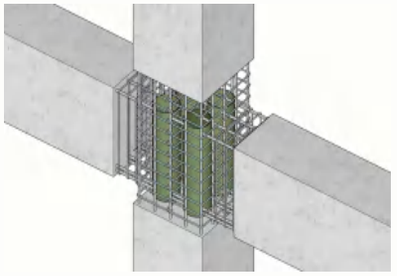
- Developed a novel type of composite joint, namely the FRP tube-concrete composite joint with the follow merits: (1)The FRP tube provides confinement to the core concrete, enhancing the shear capacity of the joint; (2) It may eliminate the need for dense reinforcement in the joint zone, improving construction efficiency and facilitating the development of green and modular construction in joint structures.
- Conducted 10 large scale FRP tube-concrete composite joint tests. The stress development and distribution of the FRP tube, column bars, and stirrups in the core area of the joint was analyzed.
- Field application demonstration of this novel FRP tube-concrete composite joint was conducted in a construction site, Lize Financial Business Area, located in Fengtai District, Beijing.

IMPACT

This project solves the shear failure problem in the core area of traditional reinforced concrete frame joints and the difficulties in construction due to dense reinforcement in the joint area. Results showed that failure in the joint zone is completely avoided with sufficient shear capacity, and a new design method based on FRP tubed-concrete joint is to be established. This project pushes the practical application of non-metallic materials like FRP in new construction,and provide a new choice for joint type in seismic regions.

4 PAPERS

- *Seismic performance of short concrete columns reinforced with steel-FRP composite bars and GFRP stirrups*
- *Seismic behavior of full-scale PEN FRP-concrete-steel double skin tubular columns*
- *Seismic performance and shear strength of HECC/RC beam-column joints with simplified reinforcement*
- *Seismic Performance of Embedded GFRP Tube-Concrete Composite Exterior Beam-Column Joints*



Innovative FRP-tubed concrete joint



Field application

1 STANDARD

- T/CSTM Standard: Technical Guide for Composite Joint Structures of FRP Composite Tube-Confined Concrete Core Columns

1 DEMONSTRATION

- Lize Digital Fintech Demonstration Park, Fengtai District Engineering Application Demonstration

Fibers, Rebars, and Fiber Composites (FRPs)

UNDER FINAL EVALUATION / 100%

2024 SFP-4
(JAN 2024 - DEC 2025)

Project Name: Research and demonstration on the performance of thermoplastic FRP stirrup

PI: Dr. LI Chenggao



BACKGROUND

Fiber reinforced thermoplastic composite bar has the advantages of repeated molding, high toughness/durability and recyclability. The bending process and forming method of thermoplastic composite bar are the key to preparing the concrete stirrups. At present, there is a lack of efficient bending devices for thermoplastic stirrups. In addition, the technologies for improving the mechanical properties of thermoplastic composite stirrups and the design methods of concrete structures are key to promoting the demonstration application of marine engineering.

AIMS AND GOALS

- To develop a bending device and forming method for thermoplastic stirrups that meet the rapid bending needs on site;
- To reveal the formation mechanism of fiber dislocation, crack defect of thermoplastic composite stirrups;
- To establish a theoretical calculation model for the bending strength of thermoplastic composite stirrups.

PROJECT TEAM

哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY



INNOVATIONS

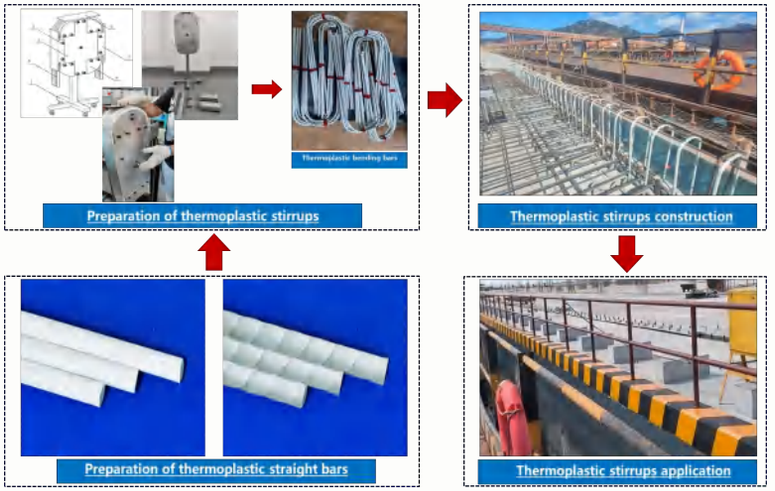
- A low-cost and high-efficiency thermoplastic stirrup bending device and a forming method are developed, which meet the requirements of rapid bending on site.
- The influence mechanism of different bending radius and bar diameter on the bending strength of stirrups was revealed.
- The improvement method of mechanical properties of thermoplastic composite stirrups based on material modification and bending process optimization is proposed.

3 PATENTS

- Fiber reinforced thermoplastic stirrup bending device and method
- Bending forming device and method of thermoplastic fiber reinforced composite stirrup
- A bending device and method

2 ENGINEERING DEMONSTRATIONS

- Fuzhou Port Luoyuanwan Port Terminal Ship Guard Demonstration
- Application/Dayangshan Offshore Engineering Base Project Demonstration Application



4 PAPERS

- *Design, preparation and mechanical properties of novel glass fiber reinforced polypropylene bending bars*
- *Long-term properties evolution and life prediction of glass fiber reinforced thermoplastic bending bars exposed in concrete alkaline environment*
- *Study on the durability of compression behavior for glass fiber-reinforced polypropylene thermoplastic composite bars in various aging environments*
- *Effect of fiber surface treatment with silane coupling agents and carbon nanotubes on mechanical properties of carbon fiber reinforced nylon 6 composites*

IMPACT

Compared with steel bars, thermoplastic bars significantly reduce carbon emissions and energy consumption during manufacturing. Weighing about half that of steel bars, thermoplastic stirrups greatly decrease the dead weight of structures, further saving resources and reducing carbon emissions by minimizing operational and maintenance times over their lifespan. A life cycle analysis over a 100-year design life indicates that the cost savings per ton of thermoplastic stirrups can reach as high as 23.79% compared to steel bars, highlighting their remarkable economic benefits.

UNDER FINAL EVALUATION / 100%

2024 PHD-4
(JAN 2024 - DEC 2025)

Project Name: Synthesis of phosphorus-containing metal-imidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin

BACKGROUND

How to simultaneously achieve excellent flame retardancy, smoke suppression, overall performance, as well as long-lasting latency and rapid curing is a challenging issue in the field of epoxy resin applications. To address this, the project aims to molecularly design and synthesize a class of phosphorus-containing metal-imidazole complex curing agents through intrinsic flame retardant technology, smoke suppression technology, and latent fast-curing technology in the organic combination of modified curing agents. This work provides valuable insights for the design and preparation of high-performance single-component epoxy resin systems.

AIMS AND GOALS

- To explore new methods for the molecular design and synthesis of imidazole-based curing agents with metal ions and phosphorus-containing groups;
- To obtain a multifunctional curing agent that integrates "long-lasting latent, rapid curing, and efficient flame retardant and smoke suppression" characteristics;
- To open up new pathways for the design and preparation of high-performance single-component epoxy resin systems.

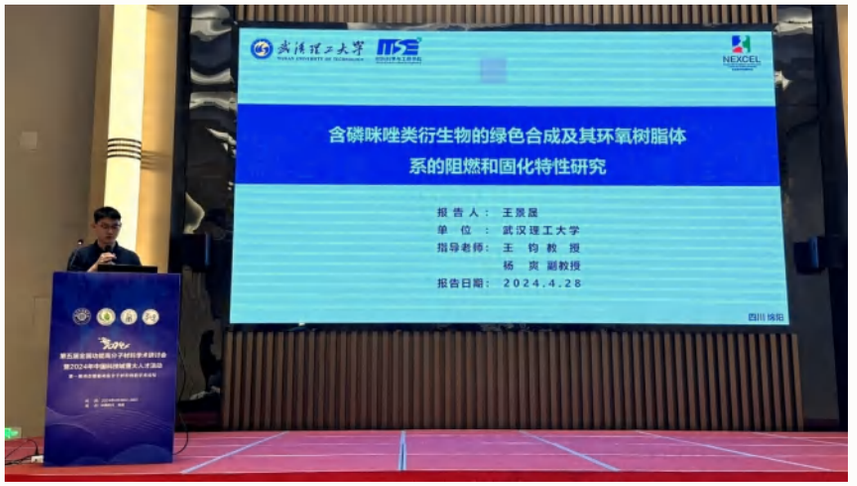
武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY



PhD Student: WANG Jingsheng

INNOVATIONS

- A series of phosphorus-containing imidazolium compounds were synthesized as multifunctional latent hardeners for one-component epoxy resins.
- The impact of the phosphorus-to-imidazole ratio in imidazolium salts on the latent reactivity, thermal stability, and mechanical properties of epoxy resin systems was systematically studied.
- A flame-retardant and smoke-suppressant latent curing agent for epoxy resins was created by incorporating phosphorus groups and metal ions into the imidazole structure



5 PAPERS

- *Multifunctional phosphorus-containing imidazoliums endowing one-component epoxy resins with superior thermal latency, heat resistance, mechanical properties, and fire safety*
- *Development of single-component epoxy resin with superb thermal stability, flame retardancy, smoke suppression, and latency via Cu-based phosphorus/imidazole-containing complex*
- *Liquid phosphorus-based bis_x0002_imidazole compounds as latent curing agents for enhancing thermal, mechanical, and flame-retardant performances of single-component epoxy resins*
- *Metal-phosphorus-imidazole synergistic complexes for enhancing latency and fire safety in single-component epoxy resins*
- *Phosphorus-derived imidazolium salts with varied oxidation states: Tailoring latency, mechanical properties, and flame retardancy in single- component epoxy resins*

1 CONFERENCE PRESENTATION

- Green synthesis of phosphorus-imidazole derivatives and their flame retardant and curing properties in epoxy resin systems

IMPACT

This project develops a series of phosphorus-containing imidazole derivatives as a single-component epoxy curing agent, integrating flame retardancy and smoke suppression to significantly enhance fire safety. The technology provides scalable, high-performance solutions for construction and electronics, mitigating fire hazards and environmental impacts, thereby promoting sustainable development in polymer materials.

Fibers, Rebars, and Fiber Composites (FRPs)

UNDER FINAL EVALUATION / 100%

2024 PHD-5
(JAN 2024 - DEC 2025)

Project Name: Research on multifunctional carbon fabric reinforced seawater sea-sand concrete composite member system

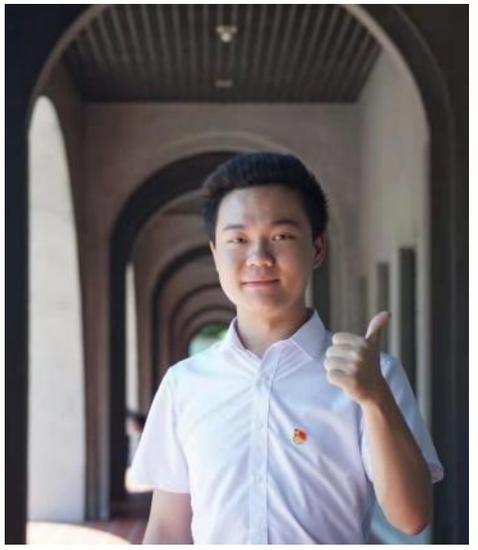
BACKGROUND

The durability issue of existing reinforced concrete structures is becoming increasingly urgent, and there is a shortage of freshwater river sand resources for new concrete projects. Based on carbon fiber's dual functions of reinforcement and self-sensing, the development of a multifunctional carbon fabric reinforced seawater and sea-sand concrete composite member system (ICCP-SS-SHM) that combines impressed current cathodic protection, structural strengthening, and structural health monitoring, can achieve construction informatization and intelligence, avoid sudden accidents in structures, and has a significant meaning.

浙江大学 ZHEJIANG UNIVERSITY

AIMS AND GOALS

- To improve the bonding performance between carbon fabric and mortar to enhance mechanical performance of the composite;
- Applying ICCP to prevent steel corrosion in structures and promoting seawater and sea sand usage to address river sand scarcity;
- Utilizing fabric modification, piezoresistive effect, and ICCP to create a multifunctional structural system for cathodic protection, structural strengthening, and health monitoring, advancing construction industry intelligence.



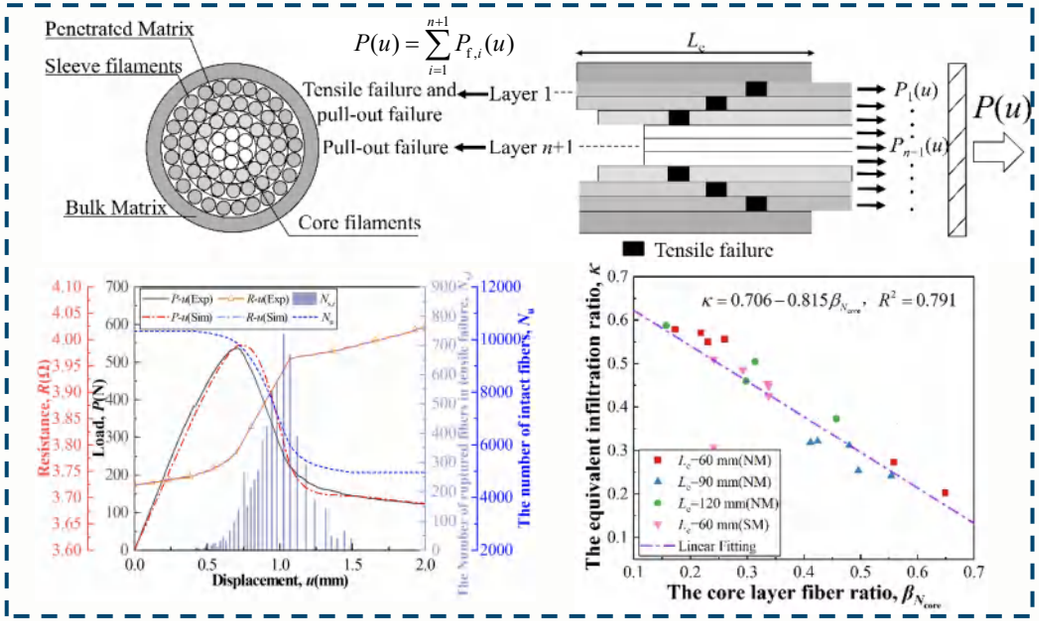
PhD Student: LIU Jiarong

INNOVATIONS

- Prediction formulas for bond performance were established based on the charge densities, mechanical parameters, and resistance parameters. The effect of ICCP on the piezoresistive effect was analyzed.
- By observing the piezoresistive effect , the sequence of crack propagation and an approximate crack location can be inferred.
- An equivalent model was developed to accurately evaluate the piezoresistive response and failure processes of CFRCM.

5 PAPERS

- *Effect of ICCP on tensile performance of carbon fiber bundles in seawater sea-sand cementitious matrix*
- *Effect of ICCP on bond performance and piezoresistive effect of carbon fiber bundles in cementitious matrix*
- *Effect of ICCP on tensile performance and piezoresistive effect of CFRCM plate*
- *A Pull-out equivalent telescopic layered failure model of carbon fiber bundles in seawater sea-sand cementitious matrix*
- *Failure model of CFRCM with ICCP modification based on piezoresistive effect*



1 CONFERENCE PRESENTATION

- "Electrical conductivity and piezoresistive response of CFRCM with ICCP" in the 10th Conference of the ACF



IMPACT

This study can promote the large-scale utilization of seawater and sea sand resources as well as the informatization and intelligent development of construction projects. It can also reduce property losses and casualties caused by sudden structural failures.

UNDER FINAL EVALUATION / 100%

2024 PHD-6
(JAN 2024 - DEC 2025)

Project Name: Ultimate and serviceability limit state design for FRP-UHPC hybrid beams

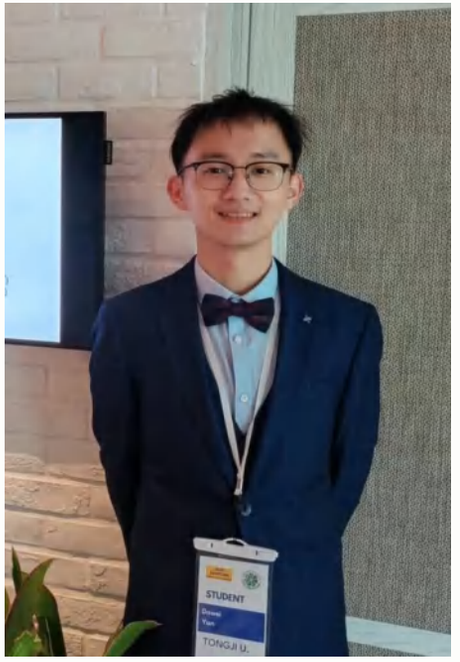
BACKGROUND

The deterioration of steel-concrete composite structures due to corrosion of structural steel and concrete degradation affects the durability and safety of the structures. UHPC and FRP are two promising alternation to concrete and steel, respectively. FRP-UHPC hybrid beams are a novel type of composite beams, and have the advantage of light weight, high strength, excellent durability, environmental friendly and rapid construction, but research on them is still scarce, which restricted the widespread application.

TONGJI UNIVERSITY

AIMS AND GOALS

- To investigate shear behavior of GFRP bolts to provide calculation method for shear bearing capacity and shear-slip model;
- To propose the creep and shrinkage model of UHPC under room temperature curing;
- To propose the ultimate and serviceability limit state design method for FRP-UHPC hybrid beams.



PhD Student: YAN Dawei

INNOVATIONS

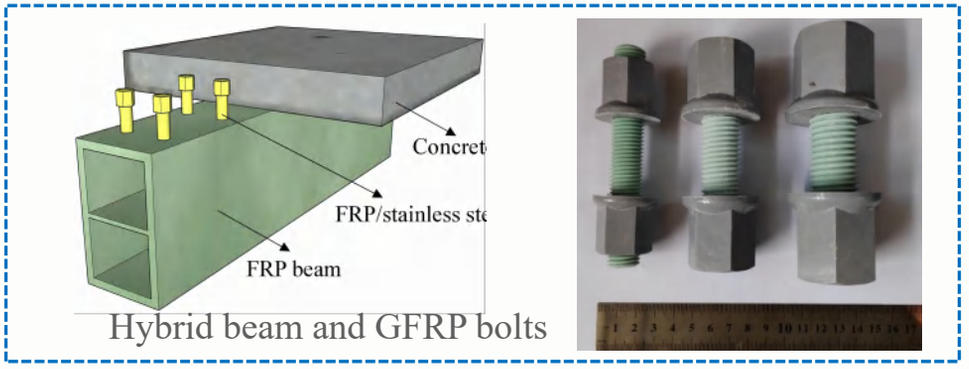
- To solve the steel corrosion and concrete deterioration in steel-PC composite beams, a novel type of FRP-PC hybrid beam has been proposed by replacing steel girder, steel strands, steel connectors, and concrete with GFRP profiles, CFRP tendons, GFRP bolts, and UHPC respectively.
- The shear behavior of bolt shear connectors made of FRP was investigated.
- A numerical investigation and parametric analysis on the static behavior of FRP-PC hybrid beams with partial connection was developed.
- A FE model on the time-dependent behavior of FRP-PC hybrid beams considering the temperature changes was developed.

2 PAPERS

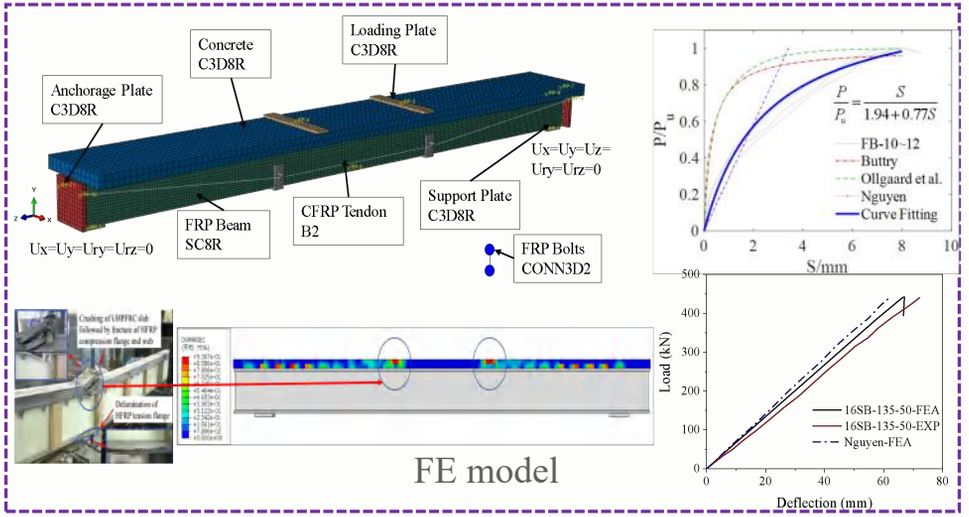
- *Effect of shear connection degree on static behavior of externally prestressed FRP-concrete hybrid beams: experimental and numerical study*
- *Experimental Study on Shear Performance of GFRP Bolt Connectors for GFRP Composite Beams -UHPC*

IMPACT

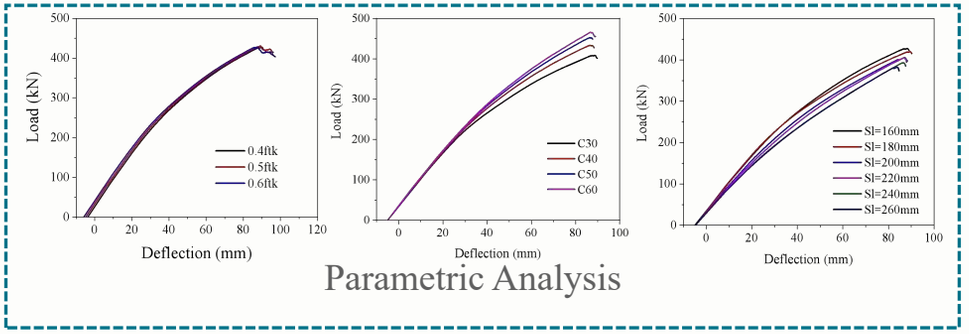
FRP-UHPC hybrid beams have advantages of lightweight, high-strength, rapid construction and durable characteristics, which enhance infrastructure safety and longevity while reducing project timelines and maintenance costs. The research results will provide a basis for the wide application of FRP-UHPC hybrid beams in bridge engineering.



Hybrid beam and GFRP bolts



FE model



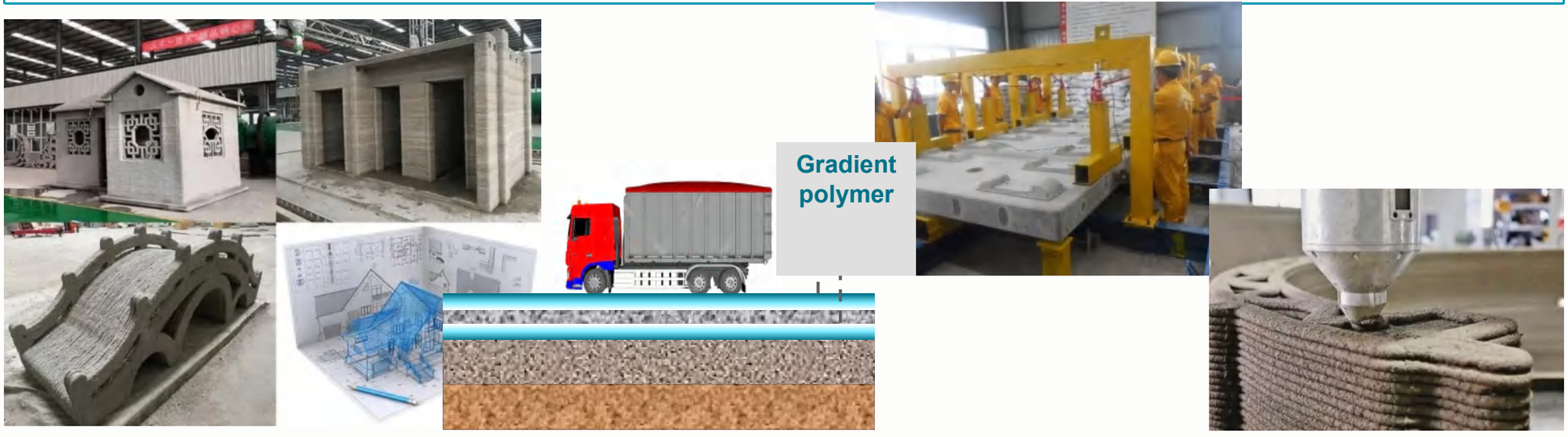
Parametric Analysis



Special Mortars & Concrete

Projects on Special Mortars & Concrete

1	22 SFP1-1	Research on 3D printed polymer modified concrete and its interface enhancement technology
2	22 SFP5-1	Study on key technology of polymer modified inferior coarse aggregate
3	23 TDA1-1	Develop hydrocarbon-based graphene for improving properties of concrete
4	23 TDA6-2	Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete
5	23 PHD-6	Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials
6	24 PHD-8	Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization
7	24 PHD-9	Preparation of railway sleeper using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties
8	24 PHD-10	Preparation and mechanism of carbon black/cementbased electromagnetic wave absorbing materials with multimechanism



COMPLETED / 100%

2022 SFP 1-1
(JUL 2022 - JUN 2023)

Project Name: Research on 3D printed polymer modified concrete and its interface enhancement technology



PI: Prof. WANG Zhendi



BACKGROUND

Concrete 3D printing enables quick and efficient completion of automatic construction of buildings. However, ordinary concrete can hardly meet the requirements of 3D printing owing to poor printability and buildability of fresh slurries. Moreover, weak bonding interface between filaments highly limits the development and application of 3D printing concrete. All these challenges may be addressed by the continually developed petroleum based products, and promote the coordinated development of concrete 3D printing and petroleum-based polymer applications.

AIMS AND GOALS

- To improve the printability of 3D printing concrete by using polymer emulsion, polyacrylamide and hydroxymethyl cellulose;
- To improve the toughness, ductility and deformability of 3D printing concrete by using polymer fibers in concrete matrix;
- To develop a polymer emulsion spraying system in synchronization during concrete 3D printing, increasing the interface strength of concrete;
- To design and manufacture a novel nylon-based saddle stitching nails reinforcement for 3D printing concrete.

PROJECT TEAM

浙江大学 ZHEJIANG UNIVERSITY

中国建筑材料科学研究总院有限公司 China Building Materials Academy Co.,Ltd.

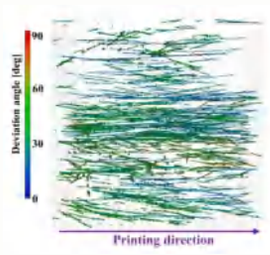
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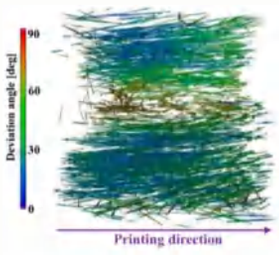
INNOVATIONS

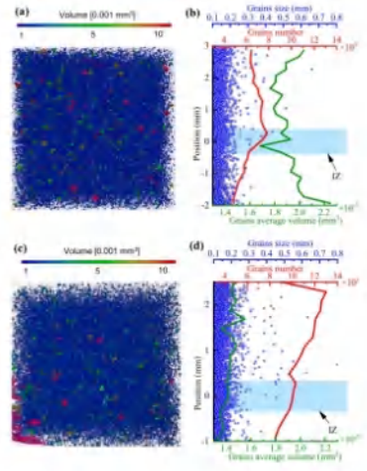
- 7.5% dosage of petroleum-based polymer emulsion improved the rheology and printability properties of cement based materials;
- 0.6% dosage of polyethylene fiber improved the toughness of 3D printing concrete, with fibers exhibiting aggregation and vertical printing direction distribution in the interlayer area, and fibers exhibiting dispersion and parallel printing direction distribution inside the matrix;
- Application of 2% nylon-based (Polyamide, PA) saddle stitching nails reinforcement technology for 3D printing concrete was greatly promoted.

3 PAPERS

- *Differences in micro grainfiber distributions between matrix and interlayer of cementitious filaments affected by extrusion molding*
- *Gradient distribution of slender glass microfibers in 3D printed cementitious filaments*
- *Rebar-matrix interface in extrusion molded cementitious filaments*







2 PATENTS

- Micro vibration method and 3D printing of concrete components
- Preparation method and application of polymer emulsion

1 STANDARD

- Test method for interfacial bonding strength of 3D-printed cement-based materials

1 DEMONSTRATION

- 3D printing polymer modified concrete for landscape water wall



IMPACT

The findings and techniques developed will overcome the limitations of ordinary 3D printing concrete materials with fragile matrix, weak bonding strength, and anisotropic structure, and achieve the reinforcement and toughening of 3D printing concrete with petroleum-based polymer materials. The innovations of materials and techniques can provide solid supports for promoting the applications of petroleum-based polymers in building materials and civil engineering, plays an important leading role in promoting the application of petroleum-based polymers in housing, bridges, gardens and municipal engineering, and would open a gate to large-scale uses of petroleum products in construction and building industry with significant economic and social benefits.

COMPLETED / 100%

2022 SFP 5-1
(JUL 2022 - JUN 2023)

Project Name: Study on key technology of polymer modified inferior coarse aggregate

BACKGROUND

At present, the global consumption of coarse aggregate for motar and concrete is still growing, but the high-quality resources are diminishing. In some islands and coastal areas, common coarse aggregate resources are scarce. Meanwhile, inferior coarse aggregate or coral reefs are widely distributed on tropical coasts and islands, but it can't be used largely for the lack of technology. If the inferior coarse aggregate could be treated and reused, which can reduce the over-dependence on natural mineral resources and carry out green and sustainable development.







Inferior coarse aggregate



Polymer modified inferior coarse aggregate

AIMS AND GOALS

- To select the optimal polymer emulsion and reactive powder concrete materials.
- To improve the application performance and meet the requirements by using the polymer modified inferior aggregate.
- To search innovative application areas for polymer modified inferior coarse aggregate.

PI: WANG Junwei

INNOVATIONS

- Ethylene vinyl acetate copolymer was applied to form a polymer mortar modifier, with the water absorption rate and adsorption capacity for admixture of polymer modified inferior coarse aggregate reduced by 80%;
- Developed the pre-mixing process for polymer modified mortar, the initial slump of concrete with polymer modified inferior coarse aggregate increased by 41% compared to unmodified, and the impermeability performance was improved.

PROJECT TEAM

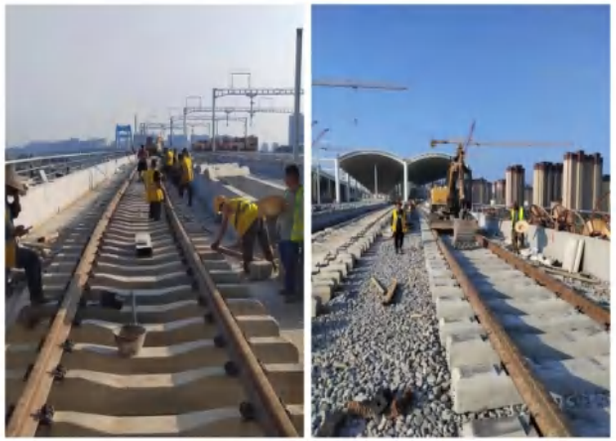
中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

1 PATENT

- One mixing and filtering machine for polymer mortar modified coarse aggregate

2 PAPERS

- *Effects of polymer-cement ratio on the properties of polymer mortar*
- *Effect of polymer modified volcanic rock coarse aggregate on properties of concrete*



1 DEMONSTRATION

Polymer modified inferior coarse aggregate applied to concrete sleepers of Beijing-Kowloon railway



Railway box girder



Railway ballastless track

IMPACT

The project achievements effectively reduce the extraction of natural aggregate resources, save land and resource occupation required for solid waste, and have a positive impact on environmental protection. Meanwhile, for areas lacking high-quality coarse aggregate resources, it can greatly alleviate the supply contradiction of coarse aggregate.

COMPLETED / 100%

2023 TDA 1-1
(JAN 2023 - JUN 2025)

Project Name: Develop hydrocarbon-based graphene for improving properties of concrete

BACKGROUND

Recently, nanomaterials have provided new research ideas in improving the mechanical properties and durability of concrete, and some achievements have been made in concrete field. Graphene has been used as an important nano-filler to improve the service performance of cement concrete materials. How to significantly reduce the cost of graphene preparation, how to achieve multi-functional regulation of the intrinsic properties of graphene and how to meet the multi-functional application requirements of graphene-based concrete materials, which are the urgent issues to be addressed.

AIMS AND GOALS

- To develop the key technologies for low-cost and mass production of hydrocarbon-based graphene with the cost no more than 200 CNY/kg;
- To investigate graphene's influence on concrete properties and their enhanced mechanism;
- To explore low-cost preparation technology of graphene concrete, carbon emission decrease no less than 10 million tons per year.

PROJECT TEAM

中山大學 SUN YAT-SEN UNIVERSITY

武漢理工大學 WUHAN UNIVERSITY OF TECHNOLOGY



PI: Dr. YING Jie

INNOVATIONS

- A systematic comparative study is conducted on the effects of commercially purchased graphene and graphene produced from petrochemical by-products on the mechanical and durability properties of concrete.
- An innovative new technology for the efficient utilization of graphene is proposed, developing graphene-modified aggregates. This reduces the amount of graphene used while significantly improving the compressive strength, flexural strength, and durability of concrete materials.

2 PAPERS

- *A two-step synthesis of porous nitrogen-doped graphene for electrochemical capacitors*
- *Improving the interfacial properties of PVA fiber and cementitious composite: Design and characterization*

1 PATENT

- Conductive cement-based materials with graphene loaded on aggregates and their preparation methods

1 STANDARD

- Graphene for cement and concrete

1 DEMONSTRATION

- Application of graphene concrete in the renovation project of the hazardous building



1 CONFERENCE REPORT

- “Research and application of graphene in concrete” in International Conference on Building Materials 2024



IMPACT

Transforming petrochemical by-products into graphene materials not only opens a new path for the large-scale application of graphene but also greatly enhances resource utilization efficiency and reduces production costs, making the application of graphene in construction more economically feasible. This innovative strategy not only aims to meet the enormous demand for graphene materials in our construction industry but also provides new growth points and opportunities for added value in the petrochemical sector, promoting the collaborative development of the upstream and downstream of the industrial chain.

COMPLETED / 100%

2023 TDA 6-2
(JAN 2023 - JUN 2025)

Project Name: Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete

BACKGROUND

The addition of polymer into the concrete can greatly improve the toughness and bonding strength of concrete. Hence, the application of polymer modified concrete is one important and efficient way to solve the fast damage of concrete pavement and increase its durability. However, one problem limiting the application of polymer in concrete is the high dosage of polymer, which significantly increases road construction costs. Considering the stress distribution of concrete pavement under load pressure, the top parts are easier to break and more polymers should be concentrated in these key areas. Therefore, it is more and more necessary to realize the local enrichment of polymer in the key areas of concrete pavement and achieve the gradient distribution of polymer inside the pavement structure.

AIMS AND GOALS

- To achieve the gradient distribution of polymer in concrete pavement and improve its mechanical property and durability.
- To build up the technology for the gradient material development and gradient structural design, for the construction of gradient reinforced polymer modified concrete.
- To realize the practical application of polymer modified concrete and promote the usage amount of polymer in the concrete road.

PROJECT TEAM

同济大学 TONGJI UNIVERSITY

TEC

清华大学 Tsinghua University

中国建筑材料科学研究总院有限公司 China Building Materials Academy Co.,Ltd.

PI: Dr. LU Zichen

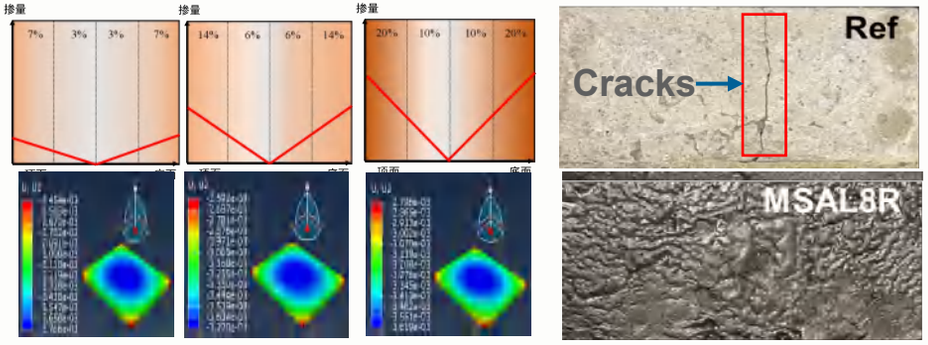


INNOVATIONS

- Magnetic responsive polymer latex was successfully synthesized;
- A finite element model of cement concrete pavement with the gradient structure was established and its reliability was verified;
- The properties of polymer-modified mortar with the gradient structure are thoroughly evaluated;
- The advanced crack and wear resistance of mortar/concrete with the incorporation of magnetic responsive polymer latex was evaluated;
- A device used for the application of magnetic responsive polymer latex was invented.
- The technique for the application of magnetic responsive polymer latex was developed.

IMPACT

The polymer modified concrete developed in the project can effectively solve the problems of weak wear resistance and crack resistance of ordinary cement concrete pavement. Meanwhile, it greatly reduces the dosage of polymer latex and its construction cost. In addition, the application of polymer latex will undoubtedly promote the use and consumption of petroleum based materials.



4 PAPERS

- *Effect of styrene acrylic latex on the performance of metakaolin blended cement: from hydration to mechanical properties*
- *Mechanical performance of polymer-modified mortar with the newly designed gradient structure: Effect of polymer types and content*
- *Research on gradient-enhanced polymer-modified concrete for structural use and comparison with conventional concrete*
- *A new method to improve the crack resistance of cement-based composites: Development of magneto-responsive polymer latex and performance evaluation*

1 PATENT

- A device invented for the application of magnetic responsive latex used in concrete pavement

1 STANDARD

- Technical specification for application of polymer modified concrete in pavement

2 DEMONSTRATIONS

- Gradient reinforced polymer modified concrete applied in Shanghai S20 Outer Ring Road and Anyang-Hebi Highway





COMPLETED / 100%

2023 PHD-6
(JAN 2023 - DEC 2024)

Project Name: Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials

湖南大学 HUNAN UNIVERSITY

BACKGROUND

Injecting a precise dose of CO_2 into cement-based materials during the process of mixing (named CO_2-ready-mix cement-based materials) has been proven to be an effective way to rapidly sequester CO_2. However, since CO_2 can only be injected within a few minutes of stirring, resulted in low carbon sequestration and mechanical performance. The preparation of ready-mix cement-based materials using desulfurized petroleum coke residue (DPCR) with high CaO content that can react with CO_2, as an admixture is expected to solve this problem. While, the feasibility and underlying mechanisms of using DPCR for the production of CO_2-ready-mix cement-based materials is still remains unclear and need to conduct research.

AIMS AND GOALS

- To fully utilize the characteristics of desulfurized petroleum coke residue (DPCR) in enhancing the carbon sequestration capacity and mechanical properties of CO_2-ready-mix cement-based materials (CBM);
- To further increase the recycling rate of petroleum coke and lowering the related CO_2 emissions from cement industry;
- To clarify the early and progressive hydration and carbonation mechanisms of the CO_2-ready-mix CBM.



PI: Prof. LING Tung Chai
Ph.D Student: LUO Shuang



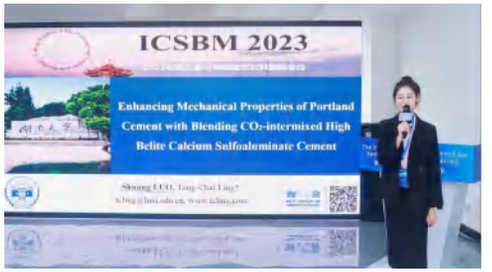
INNOVATIONS

- Injecting an accurate dose of CO_2 during paste mixing is an effective approach to quickly sequester CO_2 and enhance cement hydration.
- Introducing OPC to the K_2SO_4-intermixed DPCR paste prompts K_2SO_4 to react with $CaSO_4 \cdot 2H_2O$ in OPC paste, reducing the blended cement paste fluidity and accelerating hydration.
- The presence of $CaCO_3$ and $K_2Ca(SO_4)_2 \cdot H_2O$ in the blended OPC-DPCR paste results in a significant 100.7% increase in 1-day strength and a substantial 36.0% increase in 28-day strength.

2 CONFERENCE PRESENTATIONS

- "Enhancing mechanical properties of Portland cement with blending CO_2-intermixed high Belite calcium sulfoaluminate cement" in ICSBM 2023
- "First 60 min behavior of fresh properties and reaction mechanisms of cement pastes intermixed with CO_2" in WASCON-2023





2 PAPERS

- *Modification of early-age microstructure and enhanced mechanical properties of cement paste via injecting low-dose CO_2 at fresh stage.*
- *Effect of CO_2-mixing dose and prolonged mixing time on fresh and hardened properties of cement pastes.*

IMPACT

The use of DPCR as a partial replacement for cement in concrete production enhances resource efficiency and helps address waste storage challenges, promoting sustainable material utilization. Incorporating DPCR into concrete can significantly reduce its carbon footprint, supporting global efforts to lower CO_2 emissions in the construction industry. This approach not only contributes to environmental sustainability but also brings economic benefits by utilizing DPCR as a resource and reducing reliance on traditional cement production.

ONGOING / 75%

2024 PHD-8
(JAN 2024 - DEC 2026)

Project Name: Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization

BACKGROUND

Concrete's low toughness and flexural strength, coupled with high brittleness, lead to cracking that accelerates deterioration and reduces load capacity, impacting structural safety. Modern construction demands materials with better crack and toughness resistance. While polymers improve toughness, issues with dispersion and bonding within cementitious materials limit performance gains, and enhancing these properties remains a challenge.

TONGJI UNIVERSITY

AIMS AND GOALS

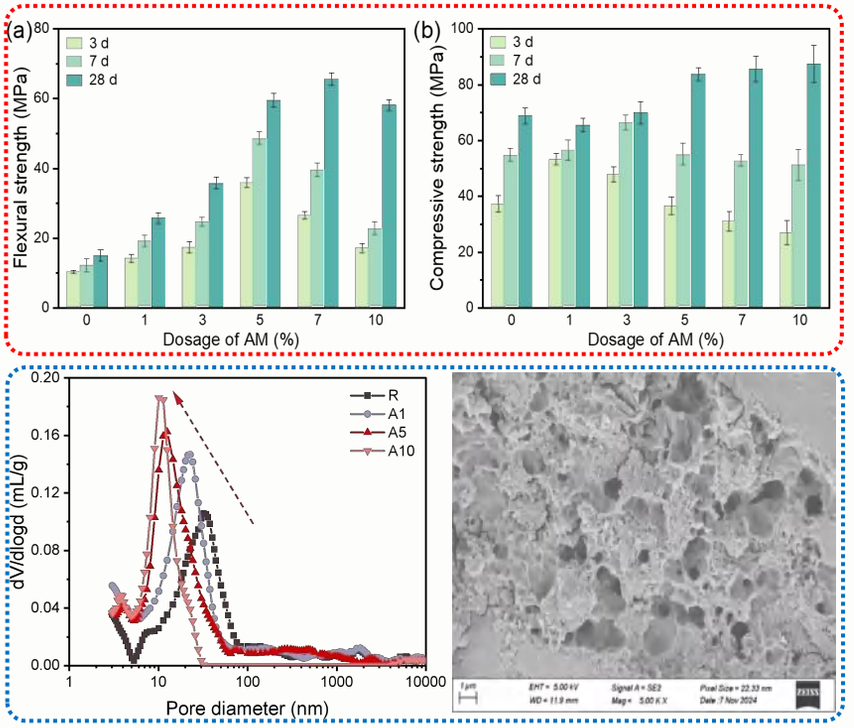
- To develop a cement-based composite material with enhanced flexural strength;
- To foster organic-inorganic bonding between monomers/polymers and cement;
- To clarify the mechanism by which in-situ monomer polymerization modifies the performance and microstructure of cement-based materials.
- To promote the application of oil-based monomers of acrylates in civil engineering materials.



PhD Student: LONG Jiangfeng

INNOVATIONS

- Comprehensively analyze effects of monomer polymerization on cement-based materials, select suitable monomers and in-situ polymerization system for Portland cement.
- Deeply analyze interaction between monomer in-situ polymerization and cement hydration kinetics. Optimize system, regulate processes to boost organic-inorganic combination, enhance composite properties and clarify mechanisms.
- Systematically study iPMCC properties and factors. Add inorganic admixtures, to enhance polymer network and its bond, boost mechanical and durability of cement-based materials.
- Conduct multi-scale research to reveal organic-inorganic bonding mechanism. Combine with macroscopic features to explore strengthening and toughening mechanisms of in-situ polymerization.



2 PATENTS

- Organic-inorganic composite modified high strength and high toughness cement-based materials and preparation methods.
- A double network polymer in-situ toughening cement-based material and its preparation method.

1 PAPER

- *Recent advance of monomer in-situ polymerization modified cement-based materials*

IMPACT

The research achievements of this project will have far-reaching impacts in multiple aspects. Doubling the flexural strength can significantly boost the stability and safety of building structure, cut disaster-related damage risks, protect public lives and property, and drive the sustainable development of construction industry.

ONGOING / 75%

2024 PHD-9
(JAN 2024 - JUN 2026)

Project Name: Preparation of railway sleepers using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties

BACKGROUND

Railway sleepers, integral to rail stability and train safety, have traditionally been made of prestressed concrete. Despite its load-bearing strength, this material's susceptibility to cracking under dynamic loads is a concern for high-speed rail safety. Recognizing this challenge, the current study introduces the use of engineered cementitious composite (ECC), a highly ductile material, aiming to diminish the incidence of cracks in railway sleepers and bolster their structural integrity and service performance.

AIMS AND GOALS

- To enhance the crack resistance of concrete and improve its durability.
- To increase the service life of prestressed railway sleepers and enhance the safety and stability of the track structure.
- To be used in railway infrastructure located in complex and difficult terrains where maintenance is challenging, aiming to reduce maintenance requirements and improve robustness.

Université de Lille



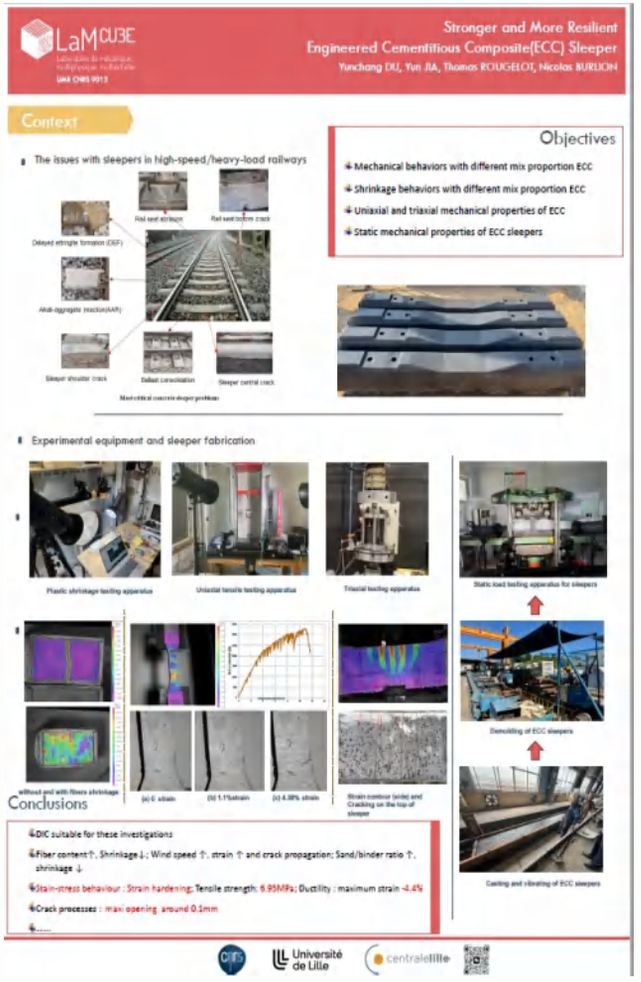
PhD Student: DU Yunchang

INNOVATIONS

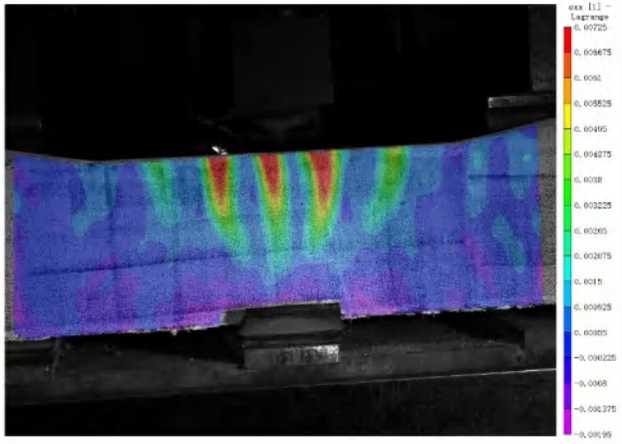
- The world's first prestressed ECC sleeper.
- Self-healing and high ductility properties.
- Adaptation to ultra-high-speed and heavy haul demands.
- Eco-friendly and sustainable development.

IMPACT

- Aligned with the national strategy for a strong transportation network.
- Promote green infrastructure development and drive the railway industry toward sustainability.
- High-durability sleepers reduce railway infrastructure maintenance, lower energy consumption during construction, and minimize construction waste emissions, contributing to the development of a low-carbon and sustainable transportation system.







UNDER FINAL EVALUATION / 100%

2024 PHD-10
(JAN 2024 - DEC 2025)

Project Name: Preparation and mechanism of carbon black/cement-based electromagnetic wave absorbing materials with multi-mechanism

BACKGROUND

As a typical petroleum-based material, carbon black (CB) has strong conductivity, high dielectric loss and low price, and has broad application prospects in electromagnetic wave (EMW) shielding building materials. The resonant cavity is an important EMW loss structure in cement-based absorbing materials, but there is a lack of research on the influence and action mechanism of CB on the resonant cavity structure, and the cement matrix lacks macro-structural optimization design, and the absorption mechanism is not clear. The application of CB in cement-based materials is limited, and the absorption performance of cement-based materials urgently needs to be improved.

AIMS AND GOALS

- To reveal the impact of CB on the resonant cavity parameters of the cement matrix, establish the relationship between CB and the resonant structure, and clarify the regulation laws of the resonant structure.
- To explore the relationship between the resonant cavity parameters and EM performance, clarify the influence mechanism of CB on EMW protection performance, and overcome the application difficulties of CB.
- To reveal the relationship between multi-scale resonant structures and absorption performance, as well as the protection frequency band, and their broadband absorption mechanism, and to develop a multi-mechanism absorbing structure construction technology.

武汉理工大学
Wuhan University of Technology



PhD Student: WU Zihao

INNOVATIONS

- A novel method for the preparation of light weight porous cement-based materials using secondary aluminum ash foaming has been developed, marking the first application of secondary aluminum ash in foamed cement-based materials.
- A scattering-resonance microstructure was constructed based on methods such as aluminum ash foaming and the incorporation of vitreous aggregates. This work revealed the regulation patterns of wave absorption performance in cement-based materials with different scattering-resonance microstructures, facilitating the controllable design of the wave absorption frequency band for light weight cement-based wave-absorbing materials.

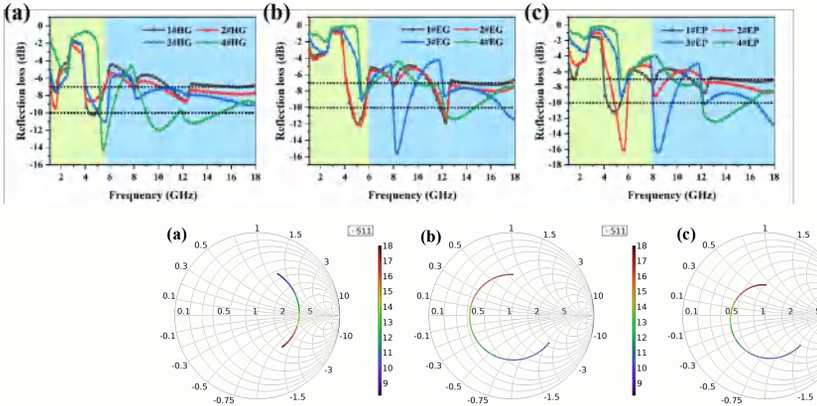
2 CONFERENCE PRESENTATIONS

The 3rd China Metamaterials Conference
The 19th Middle East Corrosion Conference and Exhibition



2 PAPERS

- *Design of microwave absorbing frequency bands and selection criteria for vitreous aggregates in cement-based materials*
- *Effects of Coal Gas Fine Ash on Electromagnetic Properties of Cement Mortar and Carbon Black Modification*



IMPACT

This work utilizes the gas-generating effect of secondary aluminum ash in an alkali-activated environment, combined with carbon black, to develop light weight cement-based wave-absorbing materials. It enhances the broadband wave absorption performance of cement-based materials, achieving an optimal wave absorption performance of -45 dB in the 1-18 GHz. This approach provides a new perspective for the recycling and utilization of secondary aluminum ash.
The controllable design of the wave absorption frequency band in cement-based materials has been achieved, providing a theoretical basis for the selection of vitreous aggregates. The high value-added application of carbon black from petroleum-based materials in wave-absorbing materials has been achieved.



Pavement
for Roads & Bridges





Projects on Pavement for Roads & Bridges		
1	22 TDA2-4	Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration
2	22 SFP3-1	Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement
3	22 PHD-2	Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate
4	23 SFP1-2	Effects of recycled plastics on the performance of asphalt mixture
5	24 TDA-3	Development and demonstration of non-metallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement
6	24 TDA-4	Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life
7	24 SFP-3	Research and demonstration on snow melting of phase change energy storage asphalt mixture
8	24 SFP-5	Application and demonstration of hydrocarbon-based graphene in asphalt mixture
9	24 PHD-1	Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement
10	24 PHD-2	Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt

COMPLETED / 100%

2022 TDA2-4
(JUL 2022 - JUN 2024)

Project Name: Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration

BACKGROUND

Hot mix asphalt not only consumes large amounts of fuel for heating, but also produces large quantities of greenhouse gases, asphalt fume and other harmful emissions. At present, it is a strategic focus of China and the world to develop the low-carbon economy and low-carbon society. Warm-mix asphalt mixture can greatly reduce the construction temperature by 20-40℃. It conforms to the concept of environmental protection, sustainable development or "green construction".

AIMS AND GOALS

- To study the characteristics of foamed warm-mix asphalt from different oil sources (including Aramco crude oil), and propose the optimal foaming parameters and production process;
- To develop new polymer additive to improve the foaming effect of asphalt, and study the migration-wetting behavior of the additive on the interface of foamed asphalt and aggregate;
- To verify asphalt mixture performance and demonstration.





PI: Dr. QIN Yongchun

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

贵州省公路工程集团有限公司
GUIZHOU HIGHWAY ENGINEERING GROUP CO., LTD

INNOVATIONS

- Using quaternary ammonium salt surfactants, polystyrene butadiene copolymer, and fatty acid alcohol amide as surfactants, the surface energy of asphalt was reduced by 24.3%.
- Additives can improve the water stability of the mixture by 2.7%, and the low-temperature performance can be improved by about 21%.
- Mechanical foaming warm mixed asphalt technology can reduce the construction working temperature by 20-30℃. The compaction effect of the pavement can reach 95%.

IMPACT

Instead of traditional hot mix asphalt for pavement, warm mix asphalt is produced at a temperature 20-40℃ lower than conventional asphalt. The immediate benefit of producing asphalt mixture at a lower temperature is the reduction in energy consumption and gas emissions, such as CO_2, fumes, and volatile gas. Benzene-Soluble Organics was dropped by 80%, and greenhouse gas emissions was reduced by over 50%.The average energy saving is about 25%.





2 PAPERS

- *Effect of warm mix agent on the chemo-mechanical performance of binder with different oil sources (SCI)*
- *Study on rheological properties of warm mixed asphalt (EI)*

1 STANDARD

- Technical specification for mechanically foamed warm mix asphalt

1 PATENT

- An activator for foam local temperature recycling mixture and its preparation method

2 DEMONSTRATIONS

- Mechanical foaming warm mix asphalt pavement in Xin Jiang G216 expressway
- Mechanical foaming warm mix asphalt pavement in tunnel of Anhui Wuyue Expressway





COMPLETED / 100%

2022 SFP 3-1
(JUL 2022 - JUN 2023)

Project Name: Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement

BACKGROUND

Aged asphalt pavement recycling technology is beneficial to the sustainable development of highway engineering. The hot-in-place regeneration technology can realize the original in-place regeneration of the aged pavement, and can quickly repair the original pavement disease. However, due to the high heating temperature of the original pavement can result to high energy consumption, serious flue gas pollution. Asphalt warm mix technology is a green pavement technology can reduce the construction temperature and achieve the purpose of reducing energy consumption, reducing greenhouse gas and harmful substances emissions.

AIMS AND GOALS

- To research and develop new additives with fast penetration and easy compaction functions for hot-in-place recycling technology of aged asphalt pavement;
- To reduce the construction temperature of hot-in-place recycled asphalt mixture by more than 30°C, compared with the traditional hot-in-place recycling technology;
- To improve the performance of in-place recycled asphalt mixture and meet the specification requirements by optimizing the mineral grading of hot-in-place recycled asphalt mixture and additives.



PI: Prof. ZENG Wei

PROJECT TEAM

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

道路绿色养护践行者
助力循环经济发展

INNOVATIONS

- The freeze-thaw splitting strength ratio of in-place warm mixed recycled asphalt mixture was increased by 2.4% by using new additives of hydrocarbon-based regenerator (polycyclic aromatic hydrocarbons extracted oil) and warm mixing agent (silane);
- Adopting in-place warm mixed regeneration technology, the construction temperature is reduced by nearly 20℃ and the energy consumption of in-place recycled asphalt mixture construction is effectively reduced.





2 DEMONSTRATIONS

- Hot in-place recycling of waste asphalt pavement in Shanghai-Shaanxi expressway
- Hot in-place recycling of waste asphalt pavement in Baotou-Maoming expressway

1 PAPER

Performance research and engineering application of in-place recycled asphalt mixture with warm mixing technology

1 PAPENT

A kind of hot-in-place recycled asphalt mixture with warm-mixed technology and its preparation method

1 STANDARD

Technical specification for clean hot in-place recycling construction of asphalt pavement

IMPACT

This project increases the benefits from the cost to carbon saving by enhancing the recycling and circularity of materials. The old asphalt pavement was fully recycled in-place, which cut the cost of road pavement, and reduces the emissions of CO_2, NO_x, and smoke by 60%, 70%, and 90% respectively.

COMPLETED / 100%

2022 PHD-2
(JUL 2022 - JUN 2024)

Project Name: Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate

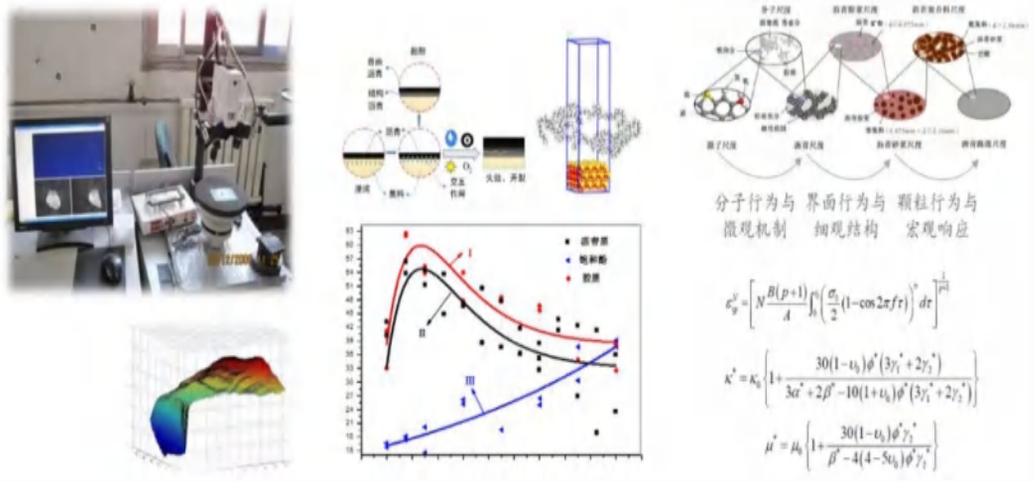
CHANG'AN UNIVERSITY 長安大學

BACKGROUND

Asphalt mixture was a multi-phase composite material, and the interface was an important factor affecting its bonding strength. Therefore, the interfacial adhesion between asphalt and aggregate has become one of the hot issues in this field in the world, and multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate was a difficult point to be overcome.



PI: Prof. ZHANG Jiupeng
PhD Student: SUN Guoqing



AIMS AND GOALS

- To clarify the physical-chemical adsorption configuration of asphalt on aggregate surface;
- To reveal the cross-scale interaction mechanism of asphalt-aggregate interface;
- To reveal the mechanism of interface degradation and failure under the coupling action of environment and load.

INNOVATIONS

- By using the analysis method of asphalt chemical element composition studied the element composition and ratio in asphalt, and established an analysis model for the influence of aggregate mineral composition on the interface performance of asphalt/aggregate;
- The adhesion behavior of asphalt/aggregate interface was studied at the molecular scale, and aggregate type has a greater impact on the interfacial adhesion energy than asphalt type, and the interfacial energy between asphalt and alkaline minerals is significantly better than that of acidic minerals.



3 PAPERS

- *Impacts of asphalt and mineral types on interfacial behaviors: a molecular dynamics study*
- *Interfacial performance of asphalt-aggregate system under different conditions based on molecular dynamics simulation*
- *Comprehensive evaluation of ballastless-track sealants based on macro–micro tests and principal component analysis*

4 CONFERENCE PRESENTATIONS

- “Research on the interface interaction energy of asphalt-aggregate by molecular dynamics simulation” in World Transport Convention 2022
- “Impacts of asphalt and mineral types on interfacial behaviors: a molecular dynamics study” in World Transport Convention 2023
- “Evaluation of the factors on interfacial bond strength and failure mode of asphalt-mineral” in The International Committee on Road and Airfield Pavement Technology 2023
- “Cross-scale analysis of interface properties and evolution behavior of asphalt-aggregate” in the 13th Youth Forum on Road and Airport Engineering Research 2024

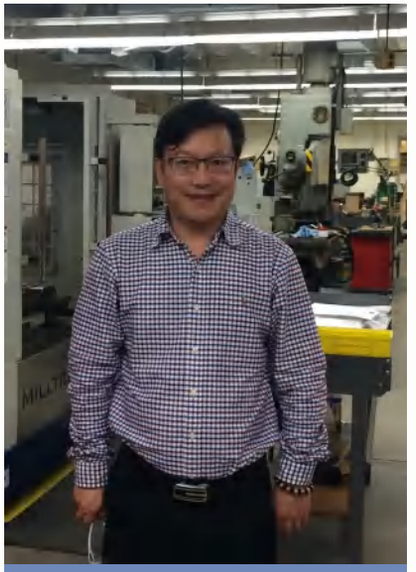
IMPACT

This project focuses on the behavior characteristics of asphalt on aggregate surface, and analyzes the bonding process of asphalt on aggregate surface from macro to micro, from mechanics to physical chemistry, from indirect evaluation to direct characterization with multi-disciplinary theory and multi-scale methods. Through the research of this project, it is expected that new progress and understanding can be made in the physical-chemical adsorption configuration of asphalt on aggregate surface, the migration law of asphalt components, and the multi-scale correlation mechanism of interface adhesion characteristics between asphalt and aggregate. The mechanism of formation, degradation and failure of asphalt-aggregate interface is revealed at molecular level.

COMPLETED / 100%

2023 SFP 1-2
(JAN 2023 - JUN 2024)

Project Name: Effects of recycled plastics on the performance of asphalt mixture



PI: Prof. HOU Shuguang

BACKGROUND

The overall recovery rate of waste plastics in China is less than 30%. Using waste plastics in asphalt mixtures is an exploratory way to dispose of waste plastics. More than 15 million tons of recycled thermoplastics will be used in the process of paving or road maintenance every year, which is the inevitable course for the reduction of plastic pollution, petroleum consumption, and promotion for the transformation of petrochemical industry to reduce CO_2 emission.

Integrating the recycled plastic industry with the road paving materials industry is the essential path to reducing plastic pollution, cutting oil consumption, and promoting the carbon transition of the petrochemical industry.

PROJECT TEAM

南京工业大学 NANJING TECH UNIVERSITY

兆维 CHOICEWAY

SQTG 宿迁交通集团 江苏宿迁交通工程建设有限公司 Jiangsu Suqian Traffic Engineering construction Co. LTD

AIMS AND GOALS

- To build up a large-scale step-adding technology for the preparation of high-content recycled thermoplastic-modified asphalt and asphalt mixture;
- To improve the directional gradation design of recycled thermosetting plastics in asphalt mixtures and find out their performance evaluation index;
- To propose the functional oriented stratification design of the paving structure for high-content recycled plastic modified asphalt mixture, as well as the pavement construction technology, and technical guidelines for pavement quality control.

INNOVATIONS

- The process and control parameters for the graded addition of recycled thermoplastics have been determined, achieving a replacement rate of recycled thermoplastic plastics no less than 20% of the asphalt, and a dynamic stability of 9000 times for asphalt mixtures.
- The step crushing and shaping production process of thermosetting plastic fillers was proposed, and the mixing process of recycled thermosetting plastic fillers in asphalt mixture (≥50%) was realized.

IMPACT

- In this project, physical and chemical modification methods on waste PE is used to improve the storage stability of polymer modified asphalt using 20% of waste PE. By improving the mixing technology of the asphalt mixture, the mixing uniformity of modified asphalt with high viscosity was achieved and high dynamic stability was obtained.
- More than 50% recycled thermosetting plastics was added into asphalt mixtures as fillers. A multi-stage grinding and screening process was built for producing waste thermosetting plastics. The waterproof and high temperature performance of asphalt mixture with 50% of recycled thermoset plastic fillers was better than laboratory tests.

1 DEMONSTRATION

Demonstrations of recycled plastics on the performance of asphalt mixture has been conducted in Suqian, Jiangsu.





2 PATENTS

- Preparation device of waste plastic modified asphalt
- Miscible storage device for waste plastic modified asphalt

1 STANDARD

- Technical specification for application of recycled plastic filler for asphalt mixture

2 PAPERS

- *Microscopic properties of asphalt and polyethylene at an extraordinary high dosage through molecular dynamics simulation*
- *Preparation method and properties of high viscosity and elasticity road asphalt modified with recycled low-density polyethylene plastic at a large dosage*

ONGOING / 70%

2024 TDA-3
(JAN 2024 - JUN 2026)

Project Name: Development and demonstration of nonmetallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement

BACKGROUND

Volatile organic components (VOCs) and many other hazardous emissions release from asphalt materials during heating process and normal service conditions. Such emissions not only lead to environmental pollution, but also result in degradation of asphalt itself. This project believes that zeolite-based additive might give a chance to reduce the hazardous emissions and provide carbon sequestration, with no negative effect on the road performance of asphalt materials.

AIMS AND GOALS

- Develop green asphalt materials with lower hazardous emissions and remark carbon sequestration behavior;
- Discover the emissions absorption mechanism in asphalt, and carbon sequestration mechanism in pavement;
- Synthesize non-metallic additives for hazardous emission reduction and carbon sequestration in asphalt materials.

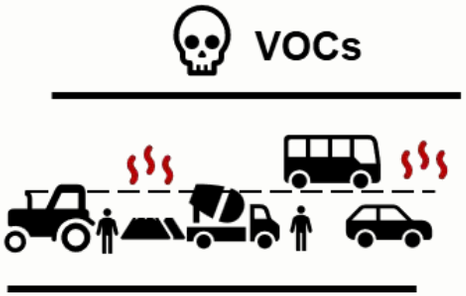


PI: Prof. XIAO Yue

PROJECT TEAM

长安大学 | 山东大学 SHANDONG UNIVERSITY | 中国能建 ENERGY CHINA | CGGC | 葛洲坝集团交通投资有限公司 GEZHOUBA GROUP TRANSPORTATION INVESTMENT CO., LTD.





INNOVATIONS

- Developed two kinds of emission reduction materials, which can be used in asphalt materials with 43% reduction of VOCs emission.
- Proposed and verified a characterization method for evaluating the carbon absorption and sequestration efficiency of asphalt pavement. And its corresponding device was developed.
- Structural control and surface chemical modification should be further carried out on the emission reduction materials to enhance the higher efficiency of gaseous pollutant reduction from asphalt pavement materials, achieving the research goal of this project.
- Based on the new materials developed in this research project, the field application technology should be forwarded, establishing a complete set of application technologies for reducing gaseous pollutants and carbon absorption and sequestration during the service life of asphalt pavement.

1 PAPER

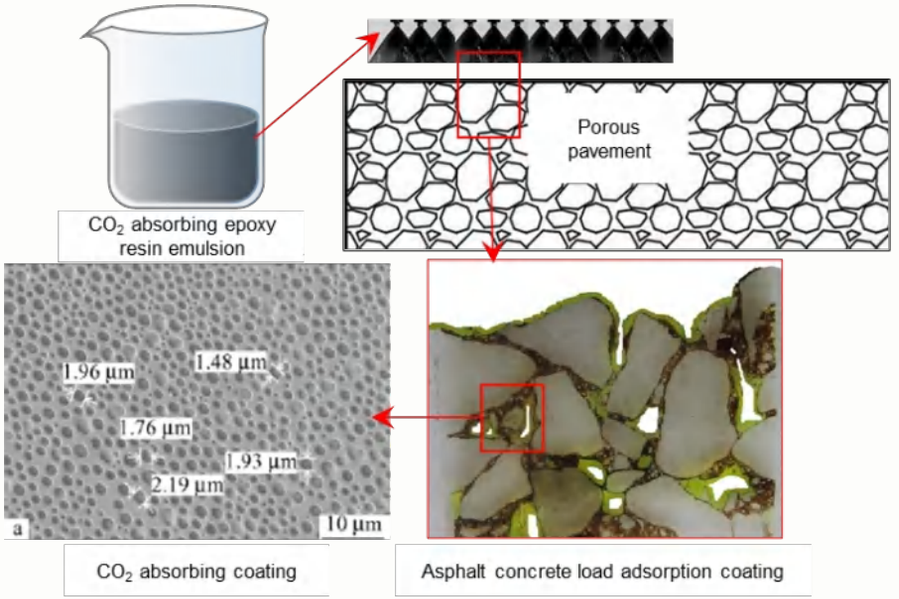
Micro-mesoporous design and modification of molecular sieve for emission reduction of asphalt VOCs.

IMPACT

Simulation and evaluation of adsorption behavior of molecular sieve VOCs on a microscopic scale.

Developed and designed ultra-low emission asphalt material based on microstructure regulation and surface modification of ZSM-5 molecular sieve.

Ecological pavement materials based on the emission reduction of gaseous pollutants – CO_2 absorption and sequestration of pavement composite efficiency mechanism.



UNDER FINAL EVALUATION / 100%

2024 TDA-4
(JAN 2024 - DEC 2025)

Project Name : Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life

BACKGROUND

Polyurethane is a kind of polymer material with excellent performance. The project uses polyurethane adhesive instead of asphalt to improve the road performance and durability. The research results are beneficial to realize the engineering application, standardized construction and industrial production of polyurethane adhesive materials in pavement engineering.

AIMS AND GOALS

- To develop and finalize a polyurethane adhesive for pavement according to the requirements of road performance and construction performance;
- To propose the material composition design method and technical index system of polyurethane mixture;
- To establish the construction technology and quality control method of polyurethane pavement based on road scene.

PI: Prof. XU Jian



PROJECT TEAM

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

WANHUA

INNOVATIONS

- By adjusting the compaction temperature and adding additives, the expansion problem of polyurethane mixture during the molding process was effectively controlled, and the expansion height of polyurethane mixture was controlled below 0.7mm.
- Based on the temperature and humidity of the construction environment, a control range for the retention time of polyurethane mixture has been proposed.

IMPACT

Compared to traditional asphalt mixtures, polyurethane mixtures can achieve room temperature mixing construction, significantly reducing energy consumption during the mixing process of road materials, and reducing CO_2 and harmful gas emissions by more than 80%. In addition, polyurethane mixtures have excellent low-temperature performance, high-temperature performance, and fatigue resistance, effectively extending the service life of pavement.

2 PATENTS

- A Quantitative Testing Method for Curing Degree of Polyurethane Mixture for Pavement Engineering.
- A Modeling Method for Molecular Dynamics Model of One-component Polyurethane Adhesive for Pavement Engineering.

3 PAPERS

- *Preparation and Performance Study of Self-migrating Waterborne Polyurethane Emulsified Asphalt Bonding Layer.*
- *Degradation mechanism and performance of polyurethane mixture under water conditions.*
- *Study on the road performance and development mechanism of polyurethane binder in different media solutions*

3 DEMONSTRATIONS

- 5.1 km of Haibin Road (from Changjiang Road to Haibin Road) in Yantai City
- 1.3 km of North Road in Penglai Park of Penglai City, Shandong Province
- 1.0 km of the logistics zone in Fujian Industrial Park







COMPLETED / 100%

2024 SFP-3
(JAN 2024 - JUN 2025)

Project Name: Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture

PI: Prof. LI Haijian



BACKGROUND

Ice and snow are the main factors affecting road safety in winter. Conventional ice and snow removal methods consist of the use of deicing chemicals and salts, snowplowing or often both. Such methods can be costly and labor intensive, may have environmental impacts, and can damage concrete pavement. The incorporation of phase change materials (PCM) in concrete pavement is suggested as an alternative method for melting and removing both ice and snow from concrete pavement surfaces or controlling thermal response of concrete pavements during hydration.

AIMS AND GOALS

- To develop a novel petroleum based phase change composite material and apply them to asphalt mixture pavement, with the target of achieving the effect of snow self-melting and deicing on road surfaces;
- Realize the goals of industrial production of petroleum-based phase change composite materials and engineering demonstration of phase change asphalt mixture pavement;
- Clarify the influence of phase change energy storage composite materials on the road performance of phase change asphalt mixtures and the mechanism of their self melting and deicing performance.

PROJECT TEAM

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

河北工業大学
HEBEI UNIVERSITY OF TECHNOLOGY

北京秦天科技集团有限公司
Beijing Qin Tian Science&Technology Group Co., LTD.

INNOVATIONS

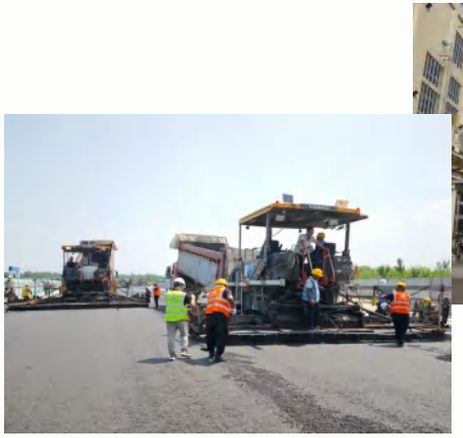
- A new type of phase change energy storage composite material with macroscopic solid and microscopic solid-liquid properties has been developed, which solves the problem of leakage in the liquid state of phase change energy storage materials, enhances the stability and durability of the composite material, and greatly improves its ability to melt snow and ice.
- We have overcome the compatibility problem between petroleum-based phase change energy storage composite materials and asphalt mixtures, laying the foundation for the engineering demonstration application of phase change energy storage asphalt mixtures.

IMPACT

- Petroleum-based phase change energy storage snow melting technology can timely and quickly melt snow on roads, with intelligent spontaneous snow melting behavior, reducing the cost of snow melting agents, labor, and the damage of snow melting agents to roads caused by snow removal.
- The application of petroleum based phase change energy storage asphalt concrete pavement reduces the extreme high and low temperature of the pavement, slows down the temperature change rate, and keeps the asphalt pavement at a stable working temperature, reducing pavement temperature diseases, extending the road performance of the mixture, and increasing the service life of the road.

Industrial production line of phase change energy storage composite particles

- Covers an area of more than 500 acres, the self-developed production line
- Intelligent and environment friendly operation progress
- An annual production capacity of up to 60,000 tons.





1 DEMONSTRATION

- MeiTai Expressway in Shaanxi Province, with a total length of 38 km and the use of 76 tons of PCCM

1 PAPER

- *A practical method for testing the properties of phase change materials and composites*

1 PATENT

- A method and device for testing the thermal performance of plate-shaped phase change energy storage components

ONGOING / 90%

2024 SFP-5
(JAN 2024 - JUN 2026)

Project Name: Application and demonstration of hydrocarbon-based graphene in asphalt mixture

PI: Prof. CHEN Meizhu



BACKGROUND

Conventional asphalt struggles to meet durability requirements due to its thermal sensitivity and poor aging resistance, calling for high-performance alternatives. Polymer-modified asphalts have been widely adopted but face cost and environmental constraints. Nanomaterials like graphene offer new potential with their unique structural properties, yet practical application is hindered by high production costs, dispersion difficulties, and compatibility issues with asphalt matrices. Key priorities include optimizing graphene content and processing conditions to achieve controlled dispersion in asphalt, as well as improving rheological properties and aging resistance to enable real-world demonstration of high-performance graphene-modified asphalt materials.

AIMS AND GOALS

- To develop a preparation technology of hydrocarbon-based graphene modified asphalt admixture with cross-scale and precise regulation of composite structure;
- To develop the preparation technology of low-cost large-scale graphene modified asphalt materials;
- To investigate the effects of graphene properties, content, structure and interface configuration on the properties of asphalt and its mixture;
- To establish the structure-activity relationship of ‘composite configuration-mechanical properties- multifunctionalization-long-term service’ .

PROJECT TEAM

武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY

中山大學
SUN YAT-SEN UNIVERSITY



INNOVATIONS

- This study employs hydrocarbon-based graphene, which offers significant advantages over graphite-derived graphene in terms of low cost and high environmental compatibility. It enables precise quantitative control over the carbon, hydrogen, and nitrogen content of the graphene material while relying on easily accessible raw materials.
- In an innovative approach, low-cost hydrocarbon-based graphene is applied to asphalt modification. This achieves the construction of a multifunctional heterogeneous composite interface in graphene-modified asphalt mixtures, along with enhanced long-term durability. The work ultimately realizes the engineering demonstration and application of high-performance hydrocarbon-based graphene-modified asphalt mixtures.

IMPACT

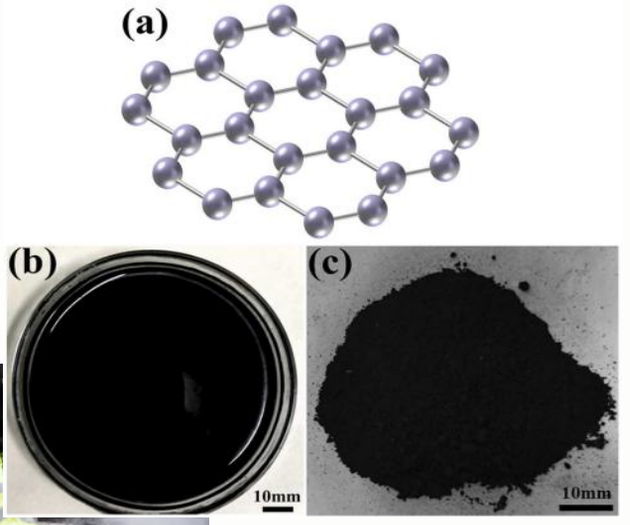
- The methods, mechanisms and applications involved in the research program of hydrocarbon-based graphene-modified asphalt mixtures developed in this project have a certain research basis and have high technical feasibility. The development of low-cost scale preparation technology from graphene to low-cost preparation technology of the mixture can greatly promote the industrialization of graphene-modified asphalt mixtures, with high economic feasibility, and the application and demonstration in asphalt mixtures have great economic, social and environmental benefits.

1 PATENT

- Hydrocarbon-based graphene modified asphalt and its preparation method
- A kind of mixing and stirring device

1 PAPER

- *Investigation on physical, rheological properties and VOCs emission of asphalt modified with hydrocarbon-based graphene*





UNDER FINAL EVALUATION / 100%

2024 PHD-1
(JAN 2024 - DEC 2025)

Project Name: Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement

BACKGROUND

Porous asphalt (PA) pavement has been widely used as a functional pavement to improve the skid resistance, water penetration, and noise reduction. However, the raveling problem is a main destress for PA at the early stage due to its high void content and faster ageing. The surface treatment (ST) emulsion, containing asphalt binder and aromatic-based rejuvenators, might be used a preventive maintenance material to effectively alleviate the raveling destress.

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

AIMS AND GOALS

- To evaluate the recovery efficiency of mechanical and functional performances of the damaged PA in laboratory using the ST emulsion;
- To understand the penetration mechanism and diffusion mechanism of ST emulsions in damaged PA mixture;
- To optimize the material design of ST emulsion and develop application guidelines on applying ST emulsion as a preventive maintenance method for PA road surfaces.



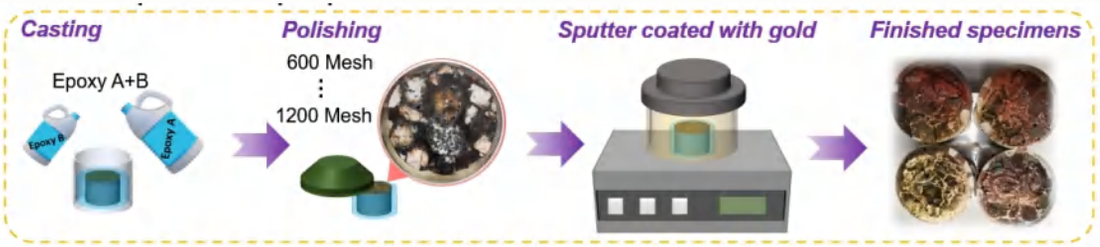
PhD Student: YANG Bin

INNOVATIONS

- The penetration depth and coating efficiency of ST emulsion in damaged PA mixture have been proved to significantly affect the ravelling resistance of PA mixture, which inspired the permeability and wettability optimizations of ST emulsion.
- The diffusion coefficient of ST residues was developed to characterize its diffusion phenomenon in aged asphalt mortar of PA mixture.
- The pretreatment method for rejuvenator was proposed, and the optimal dosage of rejuvenator in optimized ST emulsion was determined towards a better ravelling resistance of damaged PA.

3 PAPERS

- *Optimization design of asphalt emulsion with rejuvenator towards a uniform distribution inside the damaged porous asphalt mixture for a better ravelling resistance*
- *Short-and long-term mechanical performances of damaged porous asphalt mixture treated with asphalt emulsion*
- *Maintenance mechanisms of rejuvenator-optimized asphalt emulsion in mixture: Morphological, damaged porous asphalt physicochemical, and rheological characterizations*



2 CONFERENCE PRESENTATIONS

- “Characterization of diffusion of surface treatment emulsion in aged asphalt binder of porous asphalt mixture through SEM/EDS analysis”
- Multi-scale investigation on the working mechanism of preventive maintenance materials for porous asphalt pavement

IMPACT

The results of this project are expected to further deepen the understanding of the maintenance mechanism of rejuvenator-optimized emulsions in damaged PA mixtures, ultimately guiding the material design of ST emulsions and extending the service life of old PA pavements. The research results promote sustainable development and resource conservation in the road construction industry and are in line with carbon neutrality goals.

UNDER FINAL EVALUATION / 100%

2024 PHD-2
(JAN 2024 - DEC 2025)

Project Name: Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt

哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY

BACKGROUND

Improving aging resistance properties of SBS-modified asphalt could be an effective solution for both resource saving and environmental conservation. Although aging behavior has been largely discussed in the asphalt industry, SBS-modified asphalt has a complicated aging mechanism due to the presence of SBS copolymer and stabilizer. Thus, the project aims at improving the anti-aging properties and durability of SBS modified asphalt using organic materials such as waste rubber particles and carbon black, addressing the aging resistance fundamentally through a phase structure perspective.

AIMS AND GOALS

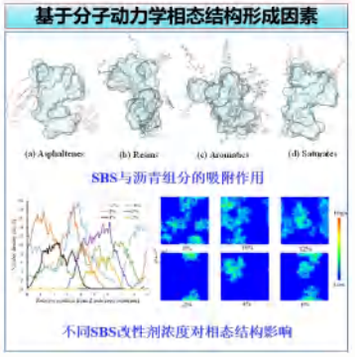
- To propose a phase structure definition based on mechanical states, and establish aging characterization indicators for SBS-modified asphalt based on the phase structure;
- To establish a method for correlating mechanical states with rheological parameters;
- To analyze the composite aging mechanisms in the multiphase system of SBS-modified asphalt, including modifiers, stabilizers, and base asphalt.

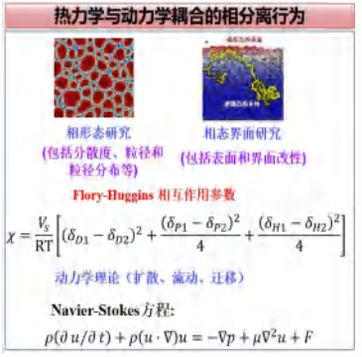


PhD Student: ZHANG Junjie

INNOVATIONS

- A method was proposed to quantitatively evaluate the ductile-brittle transition in SBS-modified asphalt, tracing its aging-related evolution from multi-phase ductile to single-phase ductile and then brittle behavior. Ten different SBS-modified asphalt systems were quantitatively assessed for anti-aging performance using a combined mechanical property and aging model approach;
- The key mechanical behavior transitions of three asphalts during aging was revealed. By evaluating various quantitative correlation methods between rheological characteristics and mechanical behavior, and exploring the applicability of various master curve models in aging analysis and the sensitivity of their parameters to aging response, this research provides a unified characterization of the transitions of different mechanical states such as viscoelastic, viscoelastic and glassy states of the material during aging.





2 PAPERS

- Investigating the role of sulfur stabilizer in modulating aging properties of SBS-modified asphalt
- Evolution of Phase Structure and Mechanical Properties in Aged SBS Modified Asphalt

1 CONFERENCE PRESENTATION

- “Quantitative characterize binder blending and diffusion in recycled asphalt mixture: an environmental-friendly solution using wooden cube and 3D fluorescence image technology” in World Transport Convention 2024



IMPACT

The impact of this research lies in providing a comprehensive understanding of the aging process of SBS-modified asphalt, advancing the development of more durable and sustainable road materials. By establishing a cross-scale correlation between macroscopic properties and microscopic mechanisms, this research contributes to the optimization of anti-aging performance and offers practical guidance for improving the design and longevity of asphalt materials, thus benefiting both the environment and society.



Construction Chemicals

Projects on Construction Chemicals		
1	22 TDA3-1	Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer
2	22 SFP2-1	Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil
3	22 PHD-3	Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials
4	23 SFP3-2	Standardization and demonstration of preparing building formwork with waste plastics
5	23 SFP4-1	Development of self-healing fire-retardant coatings highly compatible with non-metallic surfaces







COMPLETED / 100%

2022 TDA3-1
(JUL 2022 - JUN 2024)

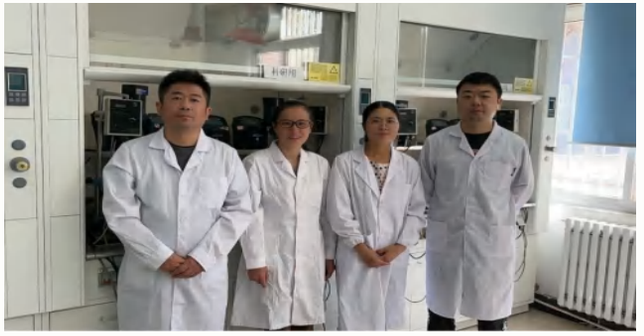
Project Name: Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer

BACKGROUND

Ultra-high performance concrete (UHPC), has achieved a great leap in the performance of engineering materials, with ultra-high strength, low brittleness and excellent durability, which can effectively compensate for many shortcomings of ordinary concrete. However, UHPC is usually reinforced and toughened by adding steel fiber or polymer fiber, resulting in poor fluidity, high viscosity, high cost of the mixture, which greatly limits its application in multiple scenarios. Develop a new type of polycarboxylate superplasticizer with ultra-high water reduction rate to reduce the water-binder ratio and obtain the good workability and ultra-high strength of UHPC.

AIMS AND GOALS

- To synthesize new type polyoxyethylene ether monomer and ultra-highly dispersing water reducer;
- To prepare UHPC concrete material with ultra-highly dispersing water reducer, and elaborate the mechanism of achieving high dispersion in ultra-low w/c ratio systems;
- To realize the reduction of cement dosage, w/c ratio, durability, CO_2 and cost in C30~C50 concrete through the different dosages of polycarboxylic acid superplasticizers.



PROJECT TEAM

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

中国建筑材料科学研究总院
中建材中岩科技有限公司
CNBM Zhongyan Technology Co., Ltd.



PI: BAI Jie

INNOVATIONS

- A novel polyether monomer was prepared by ethoxylation of unsaturated ether alcohol and ethylene oxide, and ultra-high dispersion water reducer was synthesized by free radical polymerization. When applied to C30 concrete, the water reduction rate of concrete is greater than 45%, and the amount of cementitious materials is reduced by 20%.
- UHPC containing ultra-high dispersion water reducing agent, the 1d compressive strength under non-steam curing was more than 60 MPa, 28d compressive strength was more than 150 MPa, and 28d flexural strength was more than 26 MPa.

4 PAPERS

- *Preparation and performance of EPEG-type PCE and its application in ultra-high performance concrete*
- *Research status and prospect of domestic polyether macromonomer*
- *Research on the mix proportion of low-carbon concrete utilizing a novel polycarboxylate superplasticizer*
- *Research on the effect and mechanism of binder-sand ratio on UHPC performance*

1 STANDARD

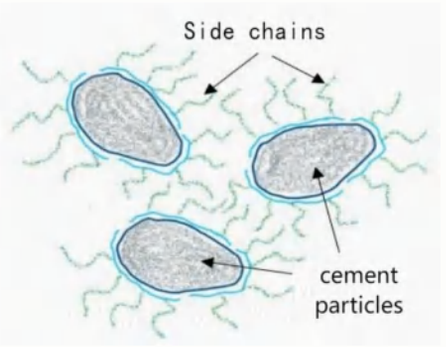
- Polyeyher and its derivatives for concrete admixtres

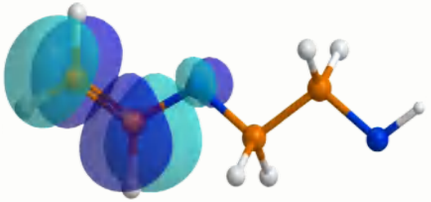
4 PATENTS

- An ultra-high dispersed water reducer and its preparation method
- An ultra-high dispersed water reducer and its preparation method
- A hyperbranched polyether and its preparation method
- An ultra-highly dispersing polycarboxylate superplasticizer and its preparation method

3 DEMONSTRATIONS

- Pilot production of novel polyether macromonomer
- Ultra-highly dispersing PCE for UHPC applied to Moshuihe Bridge and Xiaoqinghe Bridge in Shandong
- Ultra-highly dispersing PCE for low carbon concrete design applied to Dezhou City in Shandong







IMPACT

UHPC with high strength grade prepared by ultra-highly dispersing polycarboxylate superplasticizer can be used in bridge engineering such as precast bridge deck, precast box girder, bridge deck pavement, expansion joint pouring, etc. Project results can guide the reduction of cement content by more than 20% and water consumption by more than 45% by increasing the dosage of polycarboxylate superplasticizer.

COMPLETED / 100%

2022 SFP 2-1
(JUL 2022 - JUN 2023)

Project Name: Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil

PI: WANG Jian



BACKGROUND

Soil solidifying agent, which adsorbs on the surface of soil particles through ion exchange and prevents water from adsorbing again into a film to solidify the soil, is widely used in road construction. The use of solidified soil construction technology with a certain flow state or half flow state, which convenient for the construction process and reduce carbon emissions.

AIMS AND GOALS

- To form a series of solidification soil with adjustable performance according to different soil properties, different construction requirements and application scenarios;
- To prepare a special hydrocarbon-based dispersants and anti-separation agents, which are used to improve the fluidity of fluid soil, the mechanical properties and anti-dispersion properties of solidified soil;
- To realize the slump of solidified soil no less than 240 mm, the 28d compressive strength is controlled at 1.0-10.0 MPa, and the water stability coefficient is no less than 110%.



PROJECT TEAM

中国建材 中国建筑材料科学研究总院 中建材中岩科技有限公司 CNBM Zhongyan Technology Co., Ltd.

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

北京財貿職業學院 BEIJING COLLEGE OF FINANCE AND COMMERCE

INNOVATIONS

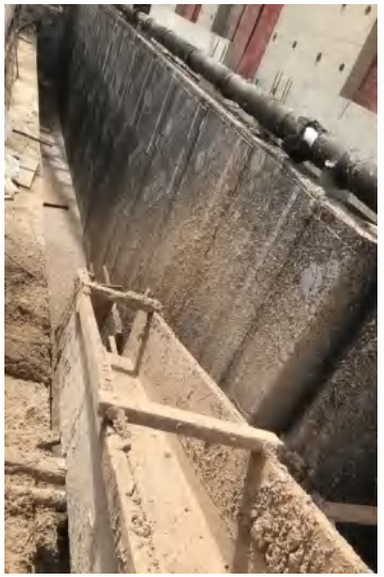
- A dispersant for ready-mixed fluid solidified soil was prepared by copolymerization of sodium methacrylate sulfonate, methyl acrylate, acrylic acid, and polyether macromers, which improved the flowability of the fluid solidified soil by over 250 mm and the slump of 1.5 h was greater than 200 mm;
- Developed resin composite technology of epoxy resin E51, fatty amine 593 and phenolic amine 8813 with backfill soil, prepared two types of polymer solidified soil by using compaction techniques with the 6 h compressive strength is 5 MPa and 7d unconfined compressive strength exceeded 30 MPa.

2 PAPERS

- *Research on properties of sulfoaluminate cement-based premixed fluid solidified soil curing agent*
- *Fluid solidification of construction waste soil*

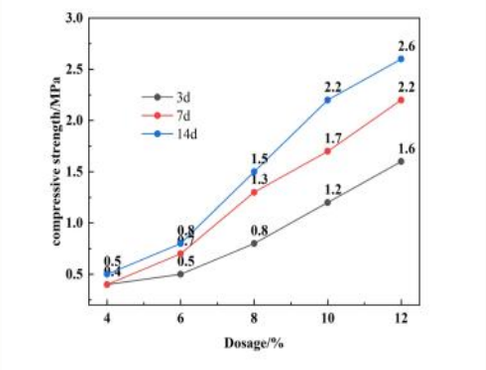
1 DEMONSTRATION

- Admixtures for solidified soil applied to fabricated building in Beijing



2 PATENTS

- A special dispersant for soil stabilizing admixture and its preparation method and application
- Anti-washout stabilizing admixtures for Solidification of underwater sludge and its preparation method and application





IMPACT

By replacing traditional inorganic solidified agents with polymer admixtures for solidified soil, which can reduce carbon emissions and atmospheric pollution, protect mining resources, and realize sustainable development. With the vigorous development of infrastructure construction in China, polymer admixtures for solidified soil have broad application prospects. Compared with traditional technologies, using polymer admixtures for solidified soil construction can save an average of 30-60% of costs.

ONGOING / 90%

2022 PHD-3
(JUL 2022 - JUN 2026)

Project Name: Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials

BACKGROUND

As a kind of thermal storage technology, a large amount of energy conversion in a small temperature range can be realized by phase change technology. Energy storage can be realized by phase change materials, which utilizes the characteristics of heat absorption during melting and heat release during solidification to achieve effective storage and utilization of heat energy. Phase change materials can be applied to construction, which has a very strong market demand and application prospects.



PI: Prof. LV Guocheng

中国地质大学
CHINA UNIVERSITY OF GEOSCIENCES
北京 · BEIJING



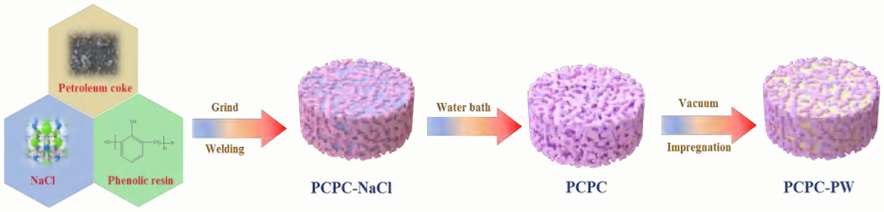
PhD: BIAN Jianhua

AIMS AND GOALS

- To prepare new petroleum coke porous carbon/paraffin composite phase change materials;
- To study thermal conductivity enhancement mechanism of petroleum coke porous carbon/paraffin composite phase change materials;
- To study thermal cycling enhancement mechanism of petroleum coke porous carbon/paraffin composite phase change materials.

INNOVATIONS

- First report on the preparation of petroleum coke porous carbon (PCPC) using salt template method, with petroleum coke as raw material and its application in paraffin wax encapsulation.
- The composite phase-change materials prepared by encapsulating paraffin wax with PCPC as the encapsulation material has good encapsulation performance, high thermal conductivity, and long thermal cycling stability.
- PCPC-PW demonstrate excellent photothermal conversion capability.
- PCPC-PW have electrothermal conversion capability.



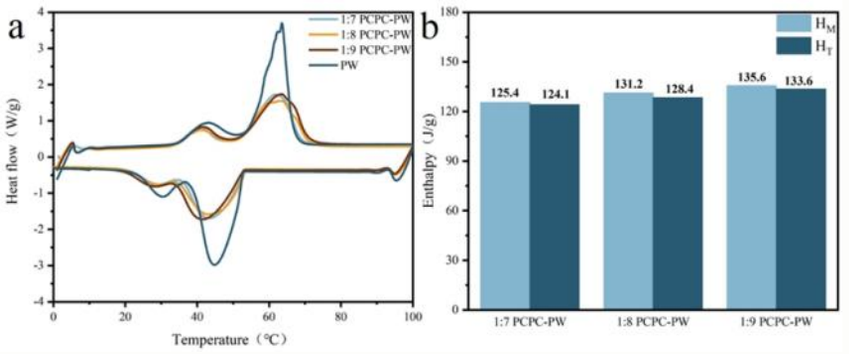
1 CONFERENCE PRESENTATION

China Materials Conference 2022-2023



2 PAPERS

- *Preparation strategy of photo-thermal composite phase change materials: a review*
- *Research progress of biomass materials in the application of organic phase change energy storage materials*



IMPACT

Hydrophobic petroleum coke porous carbon with a three-dimensional network structure was prepared using the salt template method and used for encapsulating paraffin wax. Composite phase change materials exhibit excellent heat absorption/release capabilities, while petroleum coke also endows them with the ability for photothermal and electrothermal conversion. This work provides a new method for the comprehensive utilization of petroleum coke in the field of phase change thermal management and energy.

COMPLETED / 100%

2023 SFP 3-2
(JAN 2023 - JUN 2024)

Project Name: Standardization and demonstration of preparing building formwork with waste plastics

BACKGROUND

Waste plastic causes ecological damage. Recycling is an effective way to solve the problem of waste plastics. As a new type of green and environmental protection building formwork, plastic formwork has been applied in building and bridge engineering. It can recycle waste plastics and has a broad application prospect. However, the lack of relevant standards for preparing building formwork with waste plastics limits its promotion and application.

AIMS AND GOALS

- To formulate the product standards, thus to promote the application of plastic formwork.
- To improve resource utilization of waste plastics in the preparation of building formwork, and to reduce cost and avoid pollution to ecological environment.

PROJECT TEAM

ctc 国检集团

北京交通大学 BEIJING JIAOTONG UNIVERSITY

皓强科技





PI: LIU Shunli

INNOVATIONS

- Five major general plastics and five engineering plastics were investigated from performance, application and post-waste application; Polypropylene, PVC and polycarbonate plastics suitable for the production of building formwork were selected; The use of waste plastics to prepare plastic formwork can reduce carbon emissions, such as PVC building formwork prepared with 80% waste plastics can reduce carbon emissions by 58.37% compared with raw materials.
- The proportion of waste plastic in the production of plastic formwork is more than 50%; and after third-party testing, the performance of the plastic formwork meets the technical requirements of JG/T 418-2013 “plastic formwork”, and is applied to the construction of Ziyuntai residential project in Xuchang, Henan, and the application amount reaches 6200 m^2;
- The standard of recycled plastics used in building formwork is made to ensure the quality of plastic formwork and guide the application of more types of waste plastics in construction plastic formwork.

1 STANDARD

- Group standard - 'Recycled plastics for building plastic formwork', China Building Materials Federation

1 DEMONSTRATION

- Waste plastic applied to building formwork in Xuchang, Henan

1 PRODUCTION LINE

- Building formwork with waste plastic









IMPACT

- The standard of recycled plastics used in building formwork is made to fill the gap of the lack of raw material standards in the industrial chain of plastic formwork.
- Improve the quality of plastic formwork products from the source and promote the healthy development of the plastic formwork industry.
- Guide the application of more waste plastic categories in building formwork and further promote the use of waste plastics, China‘s annual plastic building formwork market is 19 million m^2, if the use of waste plastics can reach more than 50%, more than 90,000 tons of waste plastics will be used, which is of great significance to protect the ecological environment.

COMPLETED / 100%

2023 SFP 4-1
(JAN 2023 - JUN 2024)

Project Name: Development of self-healing fire-retardant coatings highly compatible with nonmetallic surfaces

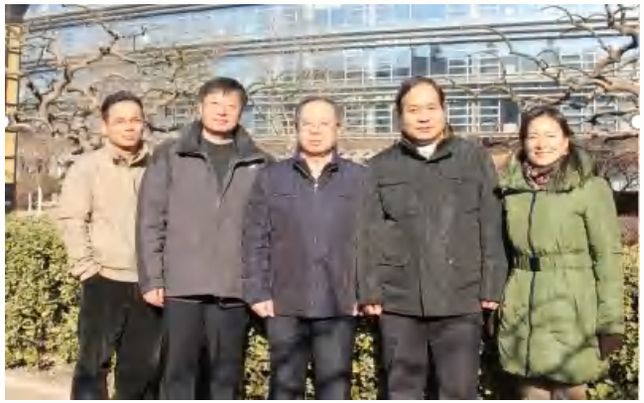
BACKGROUND

In order to make fiber-reinforced polymers (FRP) from combustible to non-combustible and to reduce the fire-catching and spreading threats to the buildings, the fire-retardant coating plays an important role in fire protection and decoration. Intumescent coatings are widely used due to their low cost and excellent fire resistance characteristics. However, when this kind of coating is subjected to external forces, it is prone to produce microcracks, resulting in poor fire resistance. The addition of self-healing fillers and flame retardants to the fire-retardant coatings is the most common and effective measure to deal with this problem, which can reduce the hazards and losses by fire.



PI: Prof. ZHAO Jingmao

北京化工大学
BEIJING UNIVERSITY OF CHEMICAL TECHNOLOGY

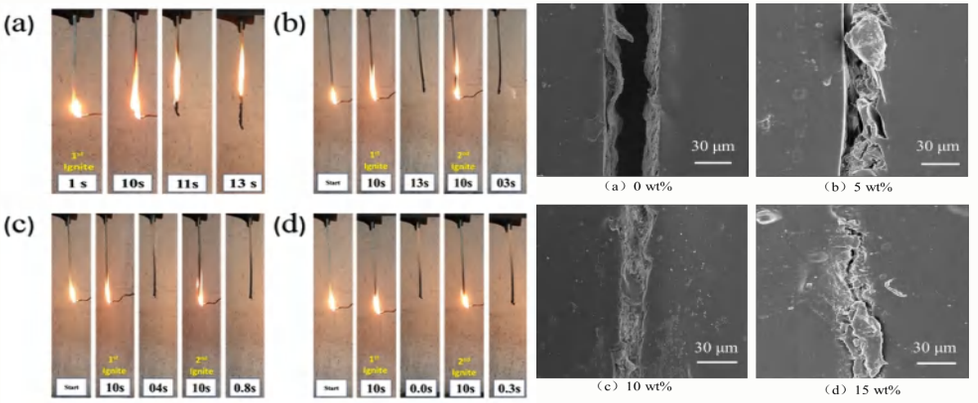


AIMS AND GOALS

- To develop a self-healing fire-retardant coating applied to the FRP surface with the addition of hydrocarbon-based flame retardants and self-healing fillers;
- To study the optimum usage of fire-retardant and self-healing additive in the coatings and their interaction;
- To carry out the research on construction technology and coating performance evaluation of fire-retardant coatings.

INNOVATIONS

- Tween-20 was used as an emulsifier to successfully synthesize microcapsules with tung oil as the core material and urea-formaldehyde resin as the wall material, and the epoxy coating with addition of 10 wt.% microcapsules exhibits excellent self-healing properties.
- 8-hydroxyquinoline (8HQ) intercalated CaAl-based layer double hydroxide (CaAl-8HQ-LDH) was loaded on rGO through one-pot hydrothermal reaction, which was employed as the nanofiller endowing epoxy coating with excellent flame-retardancy.
- The composite material with the addition of 10 wt% microcapsules and 15 wt% flame-retardant can pass the UL-94 vertical combustion test with V0 level, water resistance over 200h, and self-healing rate of 108.8%.



1 PATENT

- Preparation of a Ca-Al based layer double hydroxide nano-filler and application in corrosion and fire resistance

3 PAPERS

- *Preparation of tung oil microcapsules and their self-repairing properties*
- *Protective and flame-retardant bifunctional epoxy-based nanocomposite coating by intercomponent synergy between modified CaAl-LDH and rGO*
- *Preparation of graphene oxide encapsulated aluminum hypophosphite and its improvement on mechanical property and flame retardancy in polycarbonate/acrylonitrile-butadiene-styrene*

1 STANDARD

T/CSCP 0003-2023 'Self-healing performance evaluation methods of organic coatings

IMPACT

To make the fiber reinforcement material from combustible to non-combustible, the fire-retardant coatings are applied on the surface of the substrate. The addition of self-healing nano-fillers and flame retardants to the coatings will be the most effective strategy to deal with this problem. The flame-retardant performance of the combined coating has reached V-0 level, the strength self-healing rate within 24h is higher than 80%, and the adhesion of coating to the surface of FRP is increased by more than 20%. This technology can significantly improve the fire-retardant performance of materials, reduce the hazards and losses by fire.



Waterproofing & Repair Materials



Projects on Waterproofing & Repair Materials

1	23 TDA2-2	Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life
2	24 PHD-7	Preparation and performance of self-healing polymer modified asphalt waterproofing membrane





COMPLETED / 100%

2023 TDA2-2
(JAN 2023 - DEC 2024)

Project Name: Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life

BACKGROUND

Traditional waterproofing membranes are mainly based on asphalt based products with relatively low UV resistance, which are not suitable for outdoor projects. Thermoplastic polyolefin (TPO) waterproofing membranes have a clear structure, better mechanical properties and durability, stable quality, relatively low maintenance costs, and strong lap reliability, making them suitable for outdoor roof waterproofing projects. However, this material has the problem of flammability and insufficient long-term high-temperature durability. Therefore, this project carries out related work to develop a new type of TPO waterproof membrane.

AIMS AND GOALS

- Developing a TPO flame retardant masterbatch.
- Developing a new type of composite weather resistant additive system, which is suitable for long-term high-temperature conditions.
- Developing high flame retardant TPO coil formula and high weather resistant TPO coil formula.



PI: Dr. HU Quanchao

INNOVATIONS

- To solve the problem of dispersion and flame retardant efficiency of traditional flame retardants, POE-g-MAH polymer compatibilizer and $Mg(OH)_2$-PAPP synergistic composite flame retardant have been developed. A twin-screw extrusion granulation process for TPO masterbatch has been created, achieving efficient flame retardant modification of TPO waterproof membrane with a flame retardant grade of B2(E).
- To ensure the durability of TPO waterproofing membrane under long-term high-temperature outdoor conditions, this project focuses on the mechanisms of TPO thermal and photo oxidative aging, and conducts research on multiple aspects such as different antioxidants and various light stabilizers with their synergistic mechanisms. Based on cost-effectiveness, the product's resistance to thermal and photo oxidative aging has been improved, and it has been tested through 135 ℃ -60 days and 115℃-224 days thermal aging.

1 DEMONSTRATION

- Western Science City project in Chongqing



2 PATENTS

- A TPO composite waterproofing membrane (2024109234376)
- A waterproofing membrane (202410923013X)

2 PAPERS

- *Performance of thermal-oxidative aging on the structure and properties of ethylene propylene diene monomer (EPDM) vulcanizates*
- *Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*

1 STANDARD

- T/CECS 10374-2024 Pre-applied butyl rubber waterproof membrane

IMPACT

The product developed in this project has unparalleled advantages in durability and flame retardancy compared to similar products in the market. Compared with similar products, the lifespan of the product developed in this project can be extended to more than 25 years, reducing construction costs by 10% and energy consumption by more than 10% during the construction process.

UNDER FINAL EVALUATION / 100%

2024 PHD-7
(JAN 2024 - DEC 2025)

Project Name: Preparation and performance of self-healing polymer modified asphalt waterproofing membrane

BACKGROUND

Waterproofing membrane is an important protective material for preventing building leakage. However, polymer modified asphalt waterproofing membrane is prone to aging under the influence of environmental factors, which not only causes leakage but also greatly reduces the durability of waterproofing membrane. Therefore, it is of great significance to develop anti-aging polymer modified asphalt waterproofing membrane with self-healing function.

AIMS AND GOALS

- To improve the self-healing performance of polymer modified asphalt waterproofing membrane by breakage-rearrangement effect of dynamic disulfide bonds.
- To develop an anti-aging polymer modified asphalt waterproofing membrane with self-healing function.
- To investigate the improvement mechanism of dynamic disulfide bonds on self-healing and anti-aging performance for waterproofing membrane.

武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY



PhD Student: ZHANG Tianwei

INNOVATIONS

- It was first proposed to introduce dynamic disulfide bonds with self-healing ability into the SBS network structure, and to significantly improve the self-healing performance of SBS modified asphalt.
- It was first proposed to introduce dynamic disulfide bonds between crumb rubber to improve the self-healing performance of crumb rubber modified asphalt.
- The self-healing performance of the waterproofing membrane are significantly improved through the dynamic disulfide bonds of SBS network structure and crumb rubber particles.

IMPACT

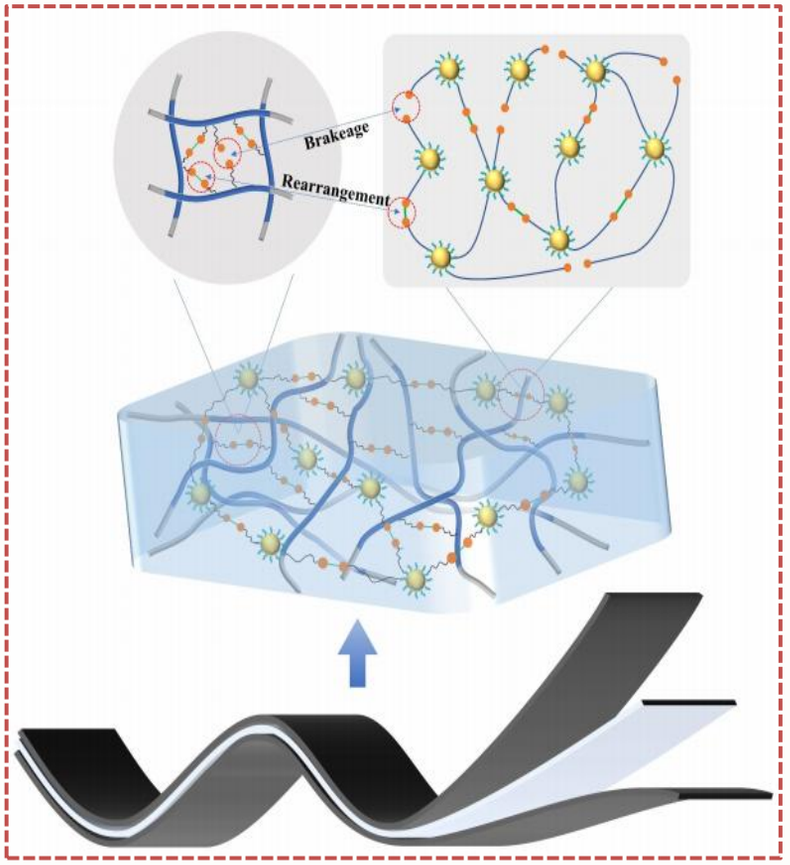
This project has developed an aging resistant polymer modified asphalt waterproofing membrane with self-healing function. The project results have laid a theoretical foundation for the development and application of self-healing polymer modified asphalt waterproofing membranes with superior aging resistance.

3 PAPERS

- *Development of sustainable desulfurized waste crumb rubber modified asphalt with enhanced self-healing properties.*
- *Multiscale study on fatigue healing performance and molecular healing behavior of self-healing SBS modified bitumen.*
- *Effect of aging on structure and properties of self-healing-enhanced SBS modified asphalt with dual dynamic chemical bonds.*

2 CONFERENCE PRESENTATIONS

- China Materials Conference “Preparation and performance study of self-healing SBS modified asphalt based on dynamic disulfide bonds”
- The 14th Youth Forum on Road and Airport Engineering Research “Preparation and performance study of self-healing crumb rubber modified asphalt based on dynamic disulfide bonds”





Insulation & Composite Cladding

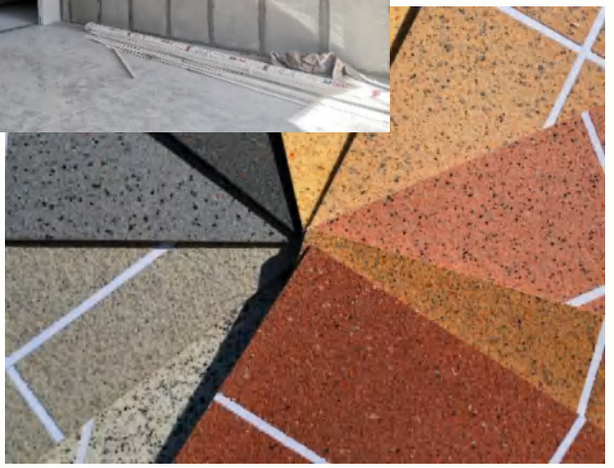
Projects on Insulation & Composite Cladding		
1	22 SFP4-1	Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel
2	23 TDA3-2	Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings
3	24 TDA-2	Development and demonstration of polymer aerogel composites
4	24 TDA-5	Develop certification for external thermal insulation composite systems (ETICS)
5	24 PHD-3	Surface modification of extruded polystyrene foam and the study of its flame retardancy and adhesion performances











COMPLETED / 100%

2022 SFP 4-1
(JUL 2022 - JUN 2023)

Project Name: Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel

BACKGROUND

Expanded Polystyrene (EPS) foam products made of styrene extracted from petroleum resources are used in various fields of society, and most of them are discarded after use, resulting in great resource waste and great damage to the ecological environment. How to effectively use abandoned EPS foam, turn waste into treasure, and reduce the secondary pollution of EPS foam is of great significance to the sustainable development of society. Waste EPS foam is used as light aggregate for recycling and utilization. Based on the problems existing in the preparation of light weight concrete with recycled EPS as aggregate and the current development trend of building assembly, recycled EPS particles, foamed concrete and calcium silicate board are used to prepare composite sandwich wall panels.

AIMS AND GOALS

- By pre-wrapping method to avoid the floating of recycled EPS particles, to achieve the uniformity and stability of recycled EPS particles/foam concrete insulation material slurry;
- To study the bubble stability in recycled EPS particles/foamed concrete slurry, and explore the solution of slurry collapse to promote the application of recycled EPS particles/foamed concrete insulation in composite sandwich wall panels;
- To propose the method of solving core material cracking and stripping core material from panel, and improve the quality of composite sandwich panel;
- To optimize the performance and construction method of recycled EPS particle/foamed concrete composite sandwich panels.



PI: Dr. LI Fangxian

華南理工大學
South China University of Technology

INNOVATIONS

- A double-coating particle pre-treatment method with coated slurry and composite coating was used to achieve the uniform distribution of EPS particles in cement-based materials, which improved the adhesion between EPS particles and cement-based materials. The mechanical properties of the resulting light weight insulation materials were increased by more than 20%.
- The production process for composite wall panels using EPS particles/foamed concrete as the core material and silicate calcium board as the surface material were obtained, and the panel has a surface density of ≤ 80 kg/m^2 and a thermal transmission coefficient of ≤ 2.0 W/m^2·K for 90 mm thick, with mechanical and thermal properties improved by over 10%.

2 PAPERS

- *Process optimization study of encapsulation method for pretreatment of recycled EPS particles*
- *Influence of slurry characteristics on the bubble stability in foamed concrete*

1 PATENT

- The invention relates to a pretreatment method for EPS particles and a preparation method for EPS particles foamed concrete







1 DEMONSTRATION

Recycled EPS/foamed concrete in composite sandwich panel applied to fabricated buildings



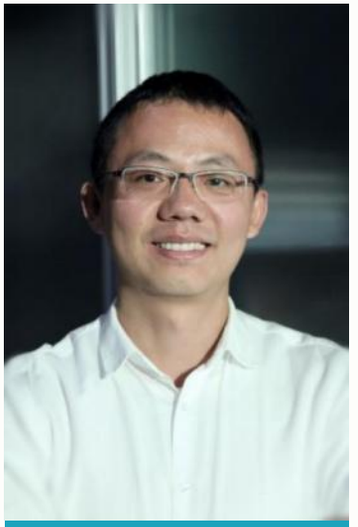
IMPACT

The application of recycled EPS particles/foamed concrete insulation material in composite sandwich wall panels can greatly reducing environmental pollution, and as an eco-friendly green building material that is energy-efficient and cost-effective, it has brought new opportunities for the development of composite wall panels and energy conservation in building. It is an effective way to achieve economic green circular development.

COMPLETED / 100%

2023 TDA 3-2
(JAN 2023 - DEC 2024)

Project Name: Research and Demonstration of Integrated Structural-Insulation Technology in Ultra-low Energy Buildings



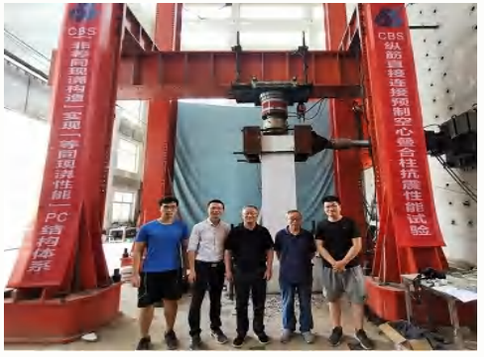
PI: Prof. XIAO Ming

BACKGROUND

Vigorously developing ultra-low energy consumption buildings is able to significantly improve building energy conservation efficiencies during their service life and is vital to achieve the targets of "dual carbon". Insulated precast concrete sandwich walls (IPCSWs) is a structural-insulation integrated technology, which realizes the same service life of the insulation system and the main structure. In order to apply IPCSWs in ultra-low energy buildings, it is necessary to comprehensively improve the thermal and combustion performance of the insulation layer, control the wall thickness and their cost and optimize the fiber-reinforced polymer (FRP) connectors.

AIMS AND GOALS

- To study the thermal performance and combustion performance of EPS, XPS, PU and PIR;
- To develop FRP connectors, optimize the mix ratio and manufacture technology, and propose the calculation methods for their tensile and shear capacity, shear-slip model and durability prediction model;
- To form a set of technologies in design-manufacture-construction of precast concrete sandwich facade (PCSF).



PROJECT TEAM

CCTC 中国建科 | 中国建筑标准设计研究院有限公司 CHINA INSTITUTE OF BUILDING STANDARD DESIGN & RESEARCH

同济大学 TONGJI UNIVERSITY

沪誉 HUYUJIANKE

WANHUA

INNOVATIONS

- A low-thermal conducting polyurethane insulation material. The thermal conductivity thermal conductivity of the polyurethane was reduced to 0.020 W/(m^2·K) by optimizing their foam structure and improving the foaming agent and silicone oil system.
- The FRP connectors complied with the guide requirements. The production process for composite wall panels using EPS particles/foamed concrete as the core material and silicate calcium board as the surface material were obtained, and the panel has a surface density of ≤ 80 kg/m^2 and a thermal transmission coefficient of ≤ 2.0 W/m^2·K for 90 mm thick, with mechanical and thermal properties improved by over 10%.

1 STANDARD

- CECS, Technical specification for connectors in precast concrete non-composite insulated sandwich wall panels.
- National Standard, Technical requirements for integrated load-bearing and insulation wall panels and connecting accessories in low-rise and mid-rise rural housing



1 PATENT

- A type of insulation wall connector

1 DEMONSTRATION

- PIR insulation material applied to ultra-low energy buildings in Beijing

7 PAPERS

- *Experimental study on seismic performance of two-story two-bay precast concrete frame with UHPC-based connections*
- *Out-of-plane response of prefabricated concrete shear walls connected via grouted sleeves*
- *Calculation method for heat transfer coefficient of ribbed composite insulated exterior wall panels*
- *Experimental study on shear performance of new insulation connectors for prefabricated sandwich insulation wall panels*
- *Finite element analysis of mechanical performance of precast concrete closely- ribbed sandwich insulated external wall panels*
- *Research on Mechanical Properties of Steel Keel-Lightweight Concrete External Wall Panel*
- *Experimental study on seismic performance of two-story two-bay. Precast concrete frame with UHPC-based connections*

IMPACT

Compared with traditional building walls with exterior insulation, the insulated sandwich walls effectively eliminate falling off the insulation, reduce the fire threats of the walls, reduce the risks of cracking and leakage, and enhance the waterproof performance.

Insulation materials and FRP connectors for the integrated structural-insulation exterior walls of ultra-low energy buildings are the key aspects of this project, and the research results will directly motivate and support the research and innovations of petroleum-based materials as well as their promotion and applications in the construction field.

UNDER FINAL EVALUATION / 100%

2024 TDA-2
(JAN 2024 - DEC 2025)

Project Name: Development and demonstration of polymer aerogel composites

NANJING TECH UNIVERSITY

AEGA 安珈新材料 AEGA ADVANCED MATERIALS

BACKGROUND

Development of polymer aerogels is an effective way to overcome the shortcoming of silica aerogels in mechanical property. However, polymer aerogels have poor thermal stability. Hence, phenolic aldehyde-SiO_2 (RF/SiO_2) hybrid aerogel is put forward. The new polymer-based aerogel composite has polymer and SiO_2 networks interpenetrated together, which improves the thermal performance and mechanical property significantly.



AIMS AND GOALS

- To achieve effective construction of the network of the polymer-based aerogel
- To break technical bottleneck of low-cost ambient pressure drying and fast supercritical drying
- To achieve industrial production and practical application of the polymer-based aerogel composites
- To achieve high-valued application of phenolic aldehyde and polymer fibers by polymer-based aerogel products



PI: Prof. KONG Yong

INNOVATIONS

- A new technology based on self-catalyzed in-situ copolymerization of hybrid precursors was developed to prepare polymer aerogels. The reaction system can spontaneously gel under mild conditions facilely without adding any catalyst.
- Phenolic aldehyde and SiO2 in polymer aerogels hybridize on the molecular scale to form interpenetrating networks, which improves the mechanical, hydrophobic, flame retardant and thermal insulation properties comprehensively.

3 PAPERS

- *Research Progress of Inorganic Hybrid Phenolic Aerogels*
- *Hydrophobic Phenolic/Silica Aerogel Composites with High Fire Safety and Strength for Efficient Thermal Insulation*
- *Hydrophobic Phenolic/Silica Hybrid Aerogels for Thermal Insulation: Effect of Methyl Modification Method*

2 PATENTS

- A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method and application
- A Calcium Ion-Enhanced Integrated Phenolic Silica Aerogel Material with Heat Insulation and Hydrophobicity and Its Preparation Methods



1 DEMONSTRATION

- Application Technology of Aerogel Composite Materials in the Student Apartment of Jiangpu Campus in Nanjing Tech University

IMPACT

Polymer aerogel composites were developed using resorcinol, formaldehyde, and phenolic resin as precursors of phenolic aldehyde, and 3-aminopropyl triethoxysilane as silica source and “internal catalyst”. The effective construction of aerogel network was realized by illustrating the growth mechanism and regulation method of the network. Based on the development of rapid supercritical drying technology, the high-performance polymer aerogel composites with a thermal conductivity of 0.017 W/(m·K), hydrophobicity of 99%, flame retardation of B1, and excellent mechanical properties were obtained. Other indexes including flatness, compression rebound rate, and water absorption rate meet the requirements of GB/T 34336-2017.

Insulation & Composite Cladding

UNDER FINAL EVALUATION / 100%

2024 TDA-5
(JAN 2024 - DEC 2025)

Project Name: Develop certification for external thermal insulation composite systems (ETICS)

BACKGROUND

ETICS has been widely promoted and applied in China for over 20 years. Up to now, ETICS has some prominent problems. The quality control and management of ETICS has become an important issue.There is no certification system based on the concept of system suppliers. To overcome this drawback, this project focuses on the fabrication of certification system of system suppliers, thus consolidating the quality management and control of ETICS in China.

AIMS AND GOALS

- To establish the certification methods and systems of ETICS;
- To compile the technical specifications and implementing regulations of ETICS certification system;
- To conduct the demonstration of ETICS certification system through related companies.

国检集团

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

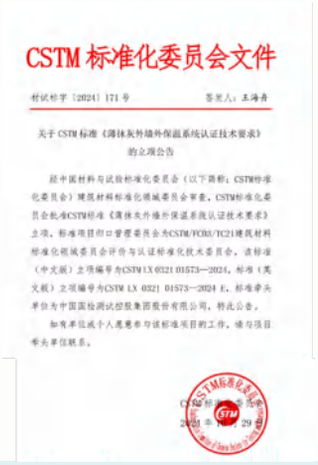


PI: ZHANG Jincheng

INNOVATIONS

- The research group closely focused on the ETICS system supplier certification system, clarified the technical capabilities and quality assurance level of system suppliers, and for the first time proposed and clarified the concept of "system suppliers".
- Established technical requirements that can be characterized and evaluated, and established mechanisms that can be identified, traced, and improved. Ensure the continuous and reliable operation of ETICS through a "technology+management" model.
- In the standard, the concept of "compatibility" was first proposed, and clear indicator requirements were put forward.




CSTM 标准化委员会文件

材试标字〔2024〕171号

关于CSTM标准《薄抹灰外墙外保温系统认证技术要求》的立项公告


目录

2 PAPERS

- *External Thermal Insulation Composite Systems (ETICS) supplier and its certification method*
- *Research on the influencing factors of the compatibility index of the exterior insulation system (ETICS) of the thin plastered exterior wall*

1 STANDARD

- *CSTM Certification Requirements for External Thermal Insulation Composite Systems (ETICS)*

IMPACT

The ETICS certification technical specification is the first certification rule for external wall insulation systems in the industry to propose the concept of system suppliers, which can improve the construction technology and quality management level of the industry. From the dual perspectives of "technology" and "management", make the exterior wall insulation industry more specialized, standardized, and regulated. The successful implementation of this project will contribute to the continuous improvement and risk tracing control of ETICS quality, and promote the healthy and stable development of China's building energy-saving industry.

UNDER FINAL EVALUATION / 100%

2024 PHD-3
(JAN 2024 - DEC 2025)

Project Name: Surface modification of extruded polystyrene foam and the study of itsflame retardancy and adhesion performances

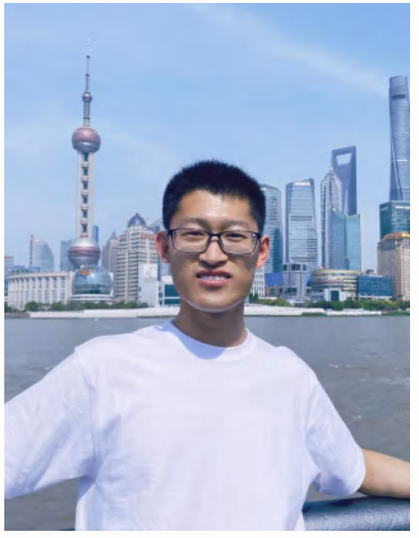
BACKGROUND

The XPSF used in external thermal insulation composite systems is extremely flammable and poorly bonded with adhesive mortar. Traditional addition of flame retardants and application of surfactant affect the performance of XPSF and the convenience of construction. Therefore, the UV curable coating is innovatively prepared to improve both these performances simultaneously. The modification coating is efficient, environmentally friendly and convenient, promoting the secure application of XPSF.

BEIJING UNIVERSITY OF TECHNOLOGY

AIMS AND GOALS

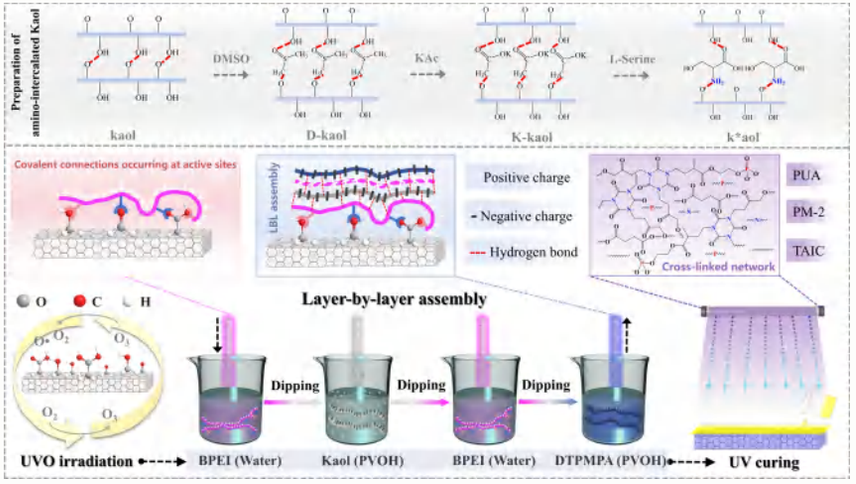
- To obtain multifunctional UV curable systems by preparing new P-N synergistic flame retardant monomers and hollow nanoparticles containing transition metals.
- To investigate the flame retardant performance and mechanism of XPSF modified with UV coating.
- To study the bonding behavior and mechanism between modified XPSF with adhesive mortar.



PhD Student: WANG Wanfu

INNOVATIONS

- UV curable polyphosphonic acid flame retardant monomer was synthesized and introduced into UV coatings to improve the flame retardancy of extruded polystyrene (XPSF).
- The bonding strength between XPSF and adhesive mortar was enhanced by the surface modification of flame retardant UV coatings.
- With the application of organic-inorganic composite UV coating via the introduction of 2% hollow LDH nanoparticles, the flame retardancy of XPSF was further improved.



2 PAPERS

- *Self-assembled coatings with durable flame retardancy for EPS foam*
- *Recycling of wind turbine blade powder into HDPE wood Enhanced mechanical and -plastic composites: flame-retardant properties via interfacial modification*

1 CONFERENCE PRESENTATION

- Synthesis of Fe-MOF flame retardant synergist and its application in flame retardant PS



IMPACT

- The flame retardancy of XPSF and interface bonding strength of XPSF/mortar are simultaneously improved via the application of organic-inorganic UV coatings.
- The project achievements can effectively simplify the construction process of exterior wall external insulation system and reduce the negative impact of flame retardants to the environment.
- This work provides guidance for improving the safety and environmental friendliness of organic foam insulation material for building.

04

ADVOCACY

ADVOCACY 2025

1 **New-tech Launch Ceremony**
5 Mainstream Media news with 1,000,000+ reads



2 **Conferences**
Special session in 79th RILEM Annual Week & Participation in 19th MECC



6 **Forums**
NEXCEL series of forums with 35,000+ views



26 **Conference Speeches**
26 speeches by NEXCEL to the public



90 **NEXCEL Articles**
5,000+ Wechat followers and 250,000+ reads

NEW-TECH LAUNCH CEREMONY

NEXCEL unveils the world’s first pavement incorporating dual-blend recycled plastics with asphalt mixtures

5 Mainstream Media News **1,000,000+** Reads





Recycled thermoplastic plastics replaced 20% of asphalt

Recycled thermosetting plastics substituted 50% of fillers









19th MECC







Executive Committee Chairman
Wail Al-Jaafari
Executive Vice President
Technical Services
Aramco

The 19th Middle East Corrosion Conference and Exhibition (MECC) took place from November 11-13, 2025, at Dhahran Expo, Kingdom of Saudi Arabia. Organized by the Materials Engineering Association, the AMPP Dhahran Saudi Arabia Chapter, and the Bahrain Society of Engineers, this biennial event has been a key platform for corrosion professionals since its launch in 1979 in the Kingdom of Bahrain.

Principal Sponsor

aramco

NEXCEL BOOTH AT MECC

Showcasing 16 NEXCEL Products & Technologies

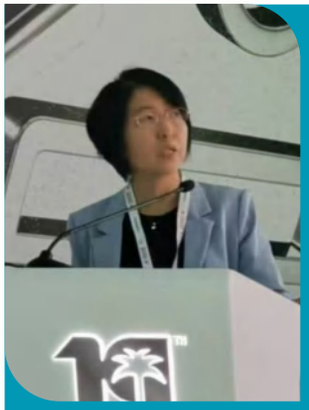








SPEECHES IN MECC



'Optimal design of structural parameters and microwave absorbing properties of cement-based pyramid-shaped configuration'



'Review on Application of Phase Change Energy Storage Building Materials'



'Synthesis of magnetic-responsive polymer latex and its magnetic response evaluation in cement-based composites'







79th RILEM ANNUAL WEEK







Dr. Li Juan gave a keynote speech entitled "Sustainable Solutions of Concrete"

NEXCEL special session 'Non-metallic for Resilient infrastructure'

6 Project PIs + 4 International Experts = 10 Speeches



LI Haijian
CBMA
"Experimental study and numerical simulation on application performance of phase change energy storage mortar"



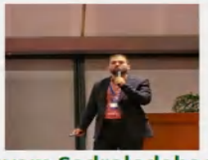
LU Zichen
Tongji University
"Research on gradient-enhanced polymer-modified concrete for structural use and comparison with conventional concrete"



Trung Nguyen Tuan
HUCE
"Evaluation of mechanical properties and durability of geopolymer concrete using sea sand and seawater"



CHANG Xiwen
Chang'an University
"Micro-mesoporous design and modification of molecular sieve for emission reduction of asphalt VOCs"



Payam Sadrolodabaee
Aston University
"Textile-reinforced mortar (TRM) panels developed with textile waste/flax fibers: flexural performance across various blended mixes"



Smadar Kedem
Technion-Israel Institute of Technology
"Spatial distribution of recycled polypropylene aggregate in mortars."



Niki Trochoutsou
Politecnico di Milano
"Imparting self-healing characteristics on cement- and lime-based textile-reinforced mortar systems."



LONG Jiangfeng
Tongji University
Ghent University
"Regulating in-situ polymerization kinetics: a key strategy for high performance cement composites"



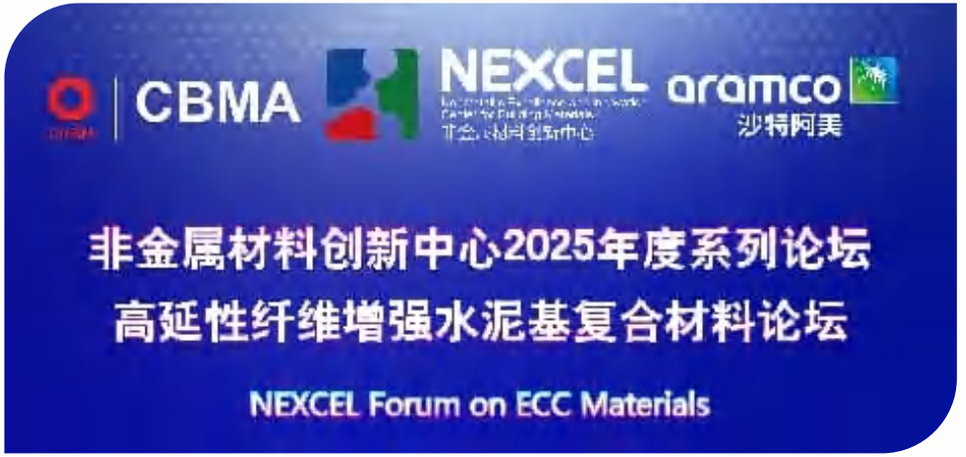
LONG Zhaofei
Central South University
"Performance evolution of polymer fiber-reinforced high-strength concrete under low-vacuum conditions"



Terrance Lim
Shanghai Jiao Tong University
"Long-term behavior of high performance GFRP bars"

NEXCEL SERIES OF FORUMS







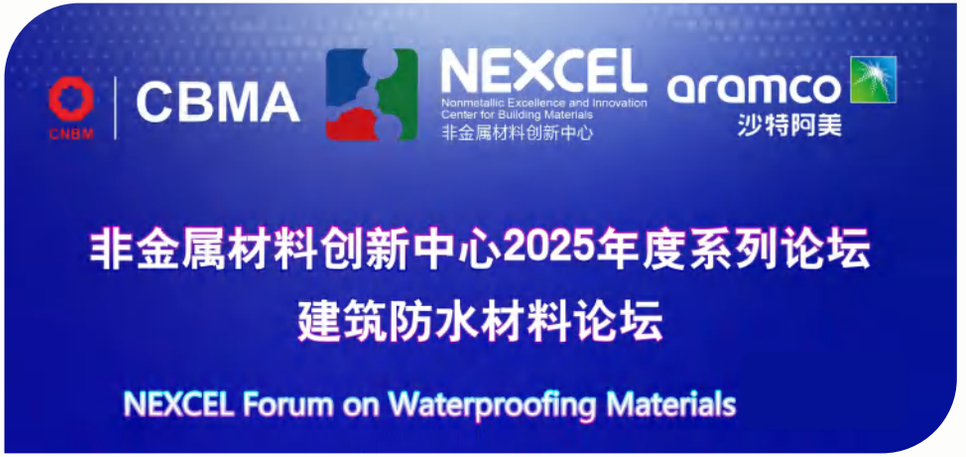






NEXCEL SERIES OF FORUMS

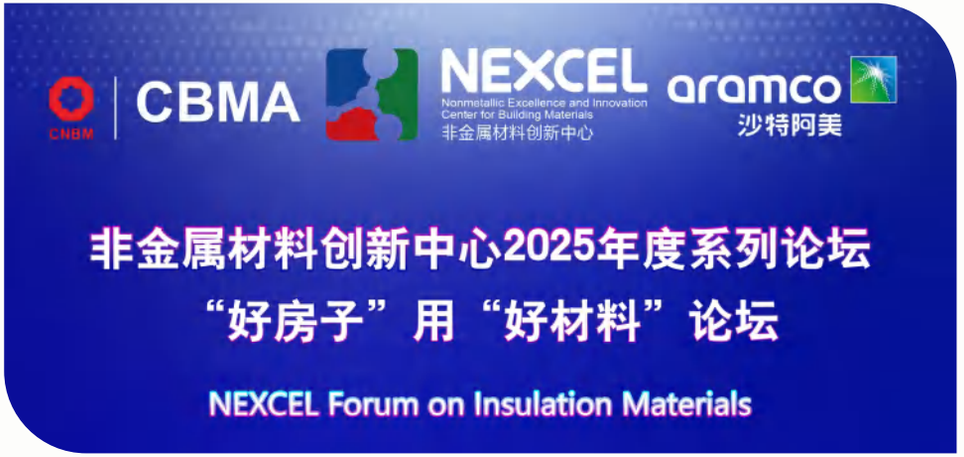








NEXCEL SERIES OF FORUMS





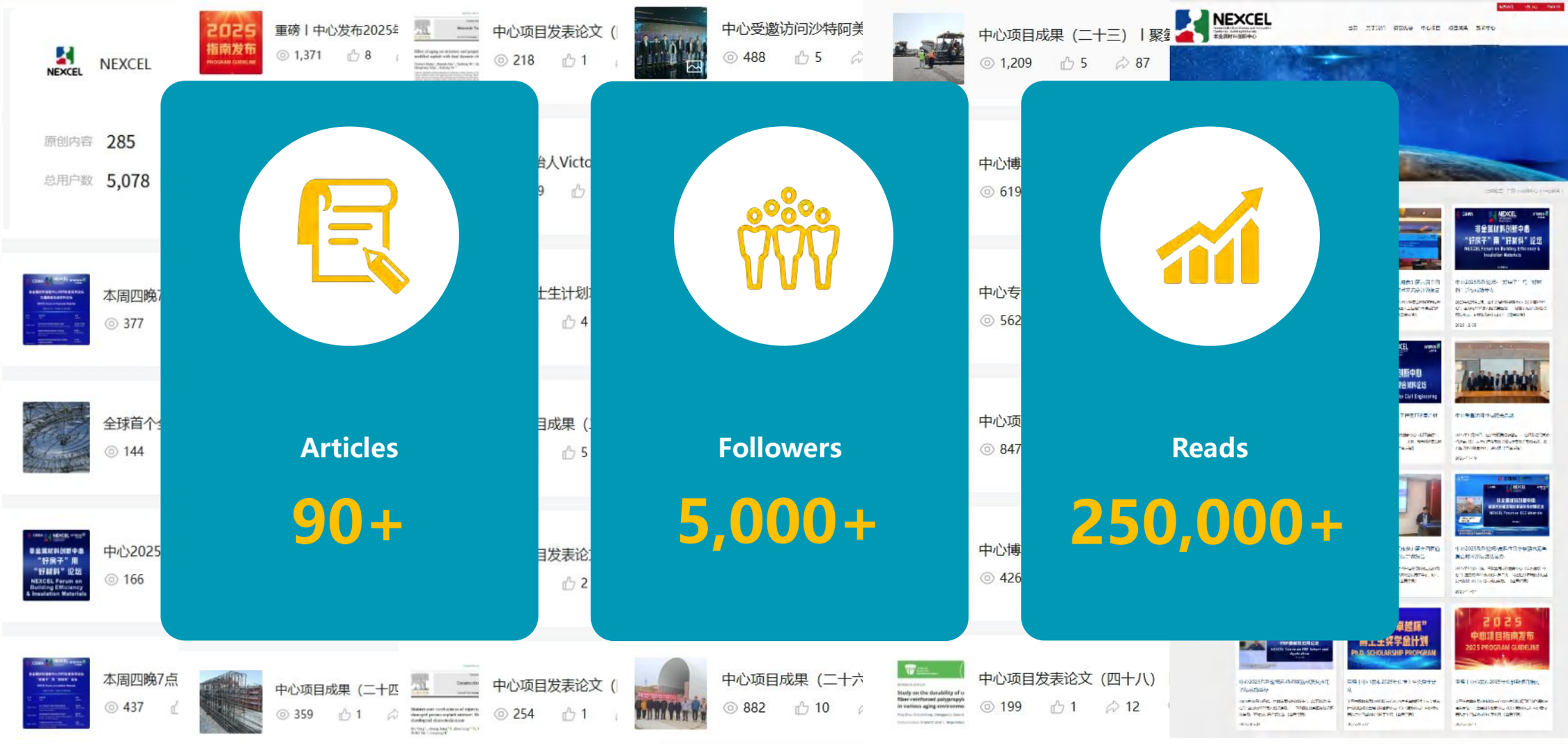








NEXCEL MEDIA RELEASE 2025



SPEECHES TO THE PUBLIC 2025

26 Conference Speeches






















OUTREACH
Aramco







NEXCEL Team Visited Aramco in Dhahran, Saudi Arabia, engaging in in-depth exchanges with NEXCEL SC members, TAC members and TSLO members

OUTREACH

Universities
University of Michigan
Tongji University
Beijing University of Technology
Chang’ an University
City University of Hong Kong















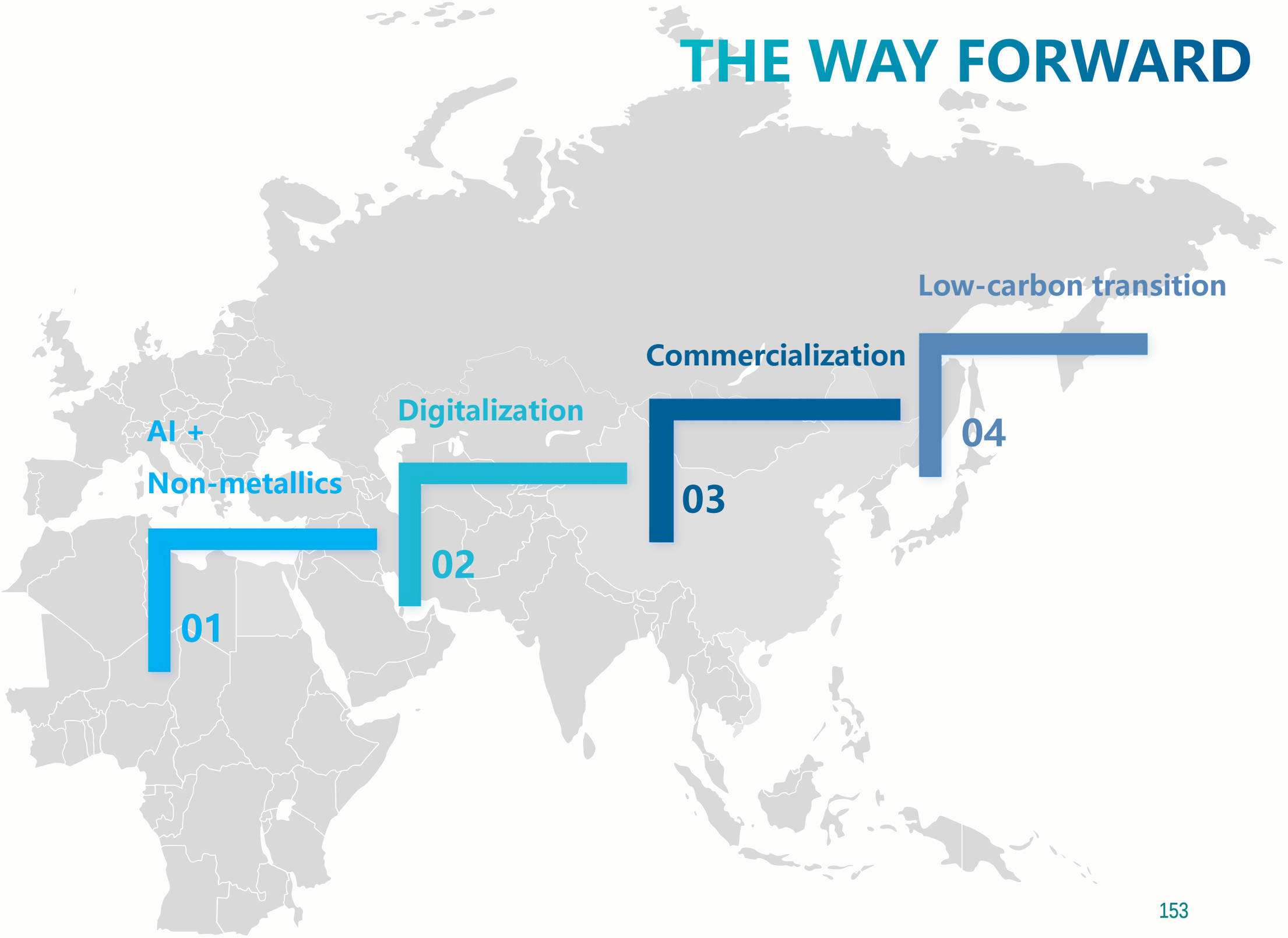


Producers & End-users
Beijing Qin Tian Sci& Tech Group
Dextra Building Products (Guangdong)
Zhongfu Shenying Carbon Fiber
ZFCC-CABLE
China Railway Sixty Group Feng Qiao
Keshun Waterproof Technology
Sinoma Overseas

05

OUTLOOK

THE WAY FORWARD



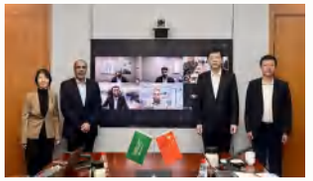
06

APPENDIX

MILESTONE

NEXCEL Convened the Seventh Steering Committee Meeting
FEB 11, 2026

NEXCEL convened its Seventh Steering Committee (SC) Meeting on February 11, 2026. The meeting was chaired by Mr. Saleh A Wohaibi, Chairman of NEXCEL Steering Committee. During the meeting, the SC members had a comprehensive review of the 2025 Summary Report and 2026 Business Plan, and approved the Recommended List of Proposals for 2025 Program and Recommended List of NEXCEL TAC/TF Manpower Placement.



NEXCEL Convened Concluding Meeting for 2024 Projects
JAN 19, 2026

NEXCEL recently convened its 2024 Project Concluding Meeting in Beijing. A panel of 15 experts was invited to review and validate the outcomes of 4 TDA projects and 2 SFP projects.



NEXCEL Releases the 2025 Program Guideline and Ph.d. Scholarship Program
OCT 17, 2025

NEXCEL releases the 2025 Program Guideline to call for 3 Technology Development and Acceleration (TDA) Project Proposals, 1 Small Fund (SFP) Project Proposal, 2 Standard & Regulation (SRP) Project Proposals, and 10 PHD Project Proposals.



NEXCEL Convened its Sixth Steering Committee (SC) Meeting
OCT 15, 2025

NEXCEL convened its Sixth Steering Committee (SC) Meeting on October 15, 2025. During the meeting, SC members reviewed the Term I Summary Report (2022-2025), and approved the 2025-2026 Business Plan and the 2025 Program Guideline.



NEXCEL Convened 2023&2024 Project Concluding Meeting
JUL 29 2025

NEXCEL convened the Project Concluding Meeting for 6 TDA Projects in 2023 and 1 SFP Project in 2024 in Beijing. NEXCEL Technical Advisory Committee(TAC) members and Technical Committee(TC) members conducted technical reviews on project outcomes and final reports.



NEXCEL Convened the 2024 Project Mid-term Review Meeting
JAN 16 2025

NEXCEL convened the Mid-term Review Meeting for the 2024 TDA projects. The Principal Investigators and key members of 5 TDA Projects attended the meeting and reported the latest progress and outcomes. The review panel, with their extensive experience and insightful perspectives, conducted rigorous reviews and posed professional inquiries to each project.



PROJECT DEMONSTRATIONS

High-performance GFRP Bars Applied in Coastal Industrial Construction



A key outcome of NEXCEL project, the development of a high-performance glass fiber-reinforced polymer (GFRP) bar, has been successfully applied in a coastal industrial construction project in Lianyungang. In total, 12000 liner meters of high-performance GFRP bars were used across the two demonstration projects. Over the full lifecycle of the structure, the adoption of GFRP reinforcement is projected to reduce CO_2 emissions by 30% and lower construction costs by 10% compared to conventional steel reinforcement.

Phase Change Material Applied in Highway Construction



Phase change material (PCM) was applied in a 38-kilometer section of Meitai Highway in Shaanxi. In this project, a total of 25,000 tons of PCM asphalt mixture containing 76 tons of PCM particles were applied at tunnel portal and on slopes. Through temperature regulation enabled by PCM, it effectively prevents ice and snow from adhering to the pavement to ensure safe and smooth traffic flow. Additionally, it can also alleviate pavement distresses such as rutting and cracking caused by thermal expansion and contraction, thereby reducing maintenance costs and extending the service life of asphalt pavement.

GFRP - Concrete Barrier Panel Demonstrated in Seawall Restoration Project



During the construction of Phase II of the Guanyun County Guanxi Section Seawall Restoration Project in Jiangsu, the project owner and contractor successfully applied the technological achievements from NEXCEL TDA project. In this project, the concrete barrier panels adopt an all-GFRP reinforced concrete structure, incorporating both GFRP longitudinal bars and GFRP stirrups. Approximately 120 tons of GFRP stirrups were used in this project, including over 30 tons of polymer, marking a successful application of hydrocarbon-based materials in coastal engineering.

Gradient Enhanced Polymer-modified Concrete in Anyang-Hebi Highway Project



The outcome of NEXCEL project, gradient enhanced polymer modified concrete, was successfully deployed on the side road of Anyang-Hebi highway project. The research team pioneered a magnetically responsive polymer latex that actively migrates within fresh concrete when activated, concentrating at pavement surfaces to form a gradient-enhanced protective layer. This intelligent material system achieves exceptional performance metrics—including over 60 MPa compressive strength, 12 MPa flexural strength, and abrasion resistance below 0.1 kg/m² at just 4% polymer dosage. The innovation delivers dual economic and engineering advantages, reducing lifecycle maintenance costs through its great durability.

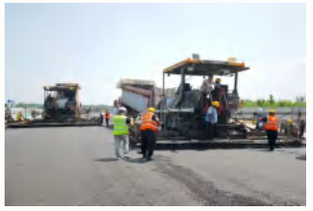
Application of High-Performance Thermoplastic GFRP Bars in Fuzhou Port Project



Thermoplastic GFRP bars was used as an alternative to steel in the wharf concrete deck slab and kerb structure of Berth 6 and 7 at Fuzhou Port. The implementation comprised: Over 2,000 linear meters of 12-mm diameter GFRP bars for concrete deck slab reinforcement; Over 230 linear meters of 12-mm diameter GFRP stirrups for kerb structural enhancement. With the advantages of multiple repeated molding, high toughness and good durability, high-performance thermoplastic GFRP bars enhance the long-term service performance of wharf concrete deck slab and kerb structure by preventing harmful cracks and improving durability.

PROJECT DEMONSTRATIONS

The Polyurethane Pavement Applied in the Urban Road Project in Jinan



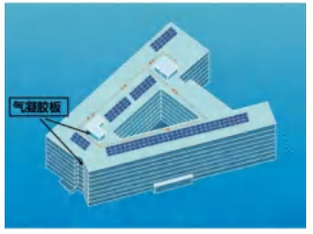
The demonstration is located in Jinan Green and Smart Industrial Park, and involves the construction of a 100-meter-long and 20-meter-wide urban road. In this demonstration, asphalt was fully replaced with polyurethane adhesive, enabling ambient-temperature mixing and paving of polyurethane mixtures. A total of 220 tons of polyurethane mixture and 12 tons of polyurethane adhesive were used.This solution significantly reduced the emission of harmful gas and greenhouse gas at the construction site, enhanced the performance and quality of polyurethane mixtures, and created favorable conditions for large-scale application of polyurethane pavement materials.

High-Performance Thermoplastic Composite bar Reinforced Concrete Prefabricated Longitudinal Beams in Dayangshan Offshore Base Project



The achievements obtained by Harbin Institute of Technology in NEXCEL Project have been successfully applied in the Dayangshan offshore base project. In the design of prefabricated high-pile longitudinal beams, the thermoplastic composite bars with a diameter of 16mm were used. Each concrete beam was equipped with 6 thermoplastic composite bars, and each bar was 6 meters long. The total usage of thermoplastic composite bars was 1080 meters. With the advantages of high toughness and good durability, the thermoplastic composite bar reinforced concrete prefabricated longitudinal beams enhanced the long-term service performance of wharf.

Application of Polymer-Based Aerogel Composites in Building Insulation Engineering



The outcome of 2024 NEXCEL TDA Project has been applied in an energy-saving renovation of student apartment in Nanjing Tech University. On the roof and west-facing exterior wall of the building, the thermosetting composite board (TSCB) and extruded polystyrene (XPS) board were replaced by polymer-based aerogel composite (PSAC) board. The PSAC board possesses excellent properties including low thermal conductivity of 0.020 W/(m·K), fire rating of A2, and has hydrophobicity of 99%. The temperature of the interior wall surface with PSAC board is 6°C lower than that with XPS board, which can significantly improve the thermal insulation performance of the wall.

Application of FRP Tube-Concrete Composite Structural Column in Beijing Lize Demonstration Project



The outcomes of 2024 NEXCEL TDA Project have been applied to a commercial building in Beijing Lize Demonstration Park. Targeting the issue of stirrup congestion and construction difficulty in beam-column joint cores within the basement structure, the project used four ±45° fiber-laid FRP tubes per joint to partially replace stirrups. Each tube measures 150 mm in diameter, 1000 mm in height, and 5 mm in wall thickness. The FRP tubes offer advantages including design flexibility, light weight, high strength, and strong durability. Their use in the joint core area not only enhances shear capacity but also reduces stirrup density, simplifying construction and improving concrete pouring quality.

FRP Rebar Reinforced Concrete for Low Vacuum Pipelines is Successfully Applied in Hyperloop Pipeline Test Platform in Beijing



The project team developed the specialized concrete for low-vacuum pipelines by effectively integrating low-magnetic FRP rebars, fiber-reinforced concrete, as well as hydrocarbon-based concrete coating. With its low magnetic resistance, high toughness, and high durability, this specialized concrete enhances the long-term service stability of pipeline and reduces magnetic interference for train operations.

EVENTS & CONFERENCES & FORUMS

NEXCEL Unveils the World’ s First Pavement Incorporating Dual-blend Recycled Plastics with Asphalt Mixtures
APR 14, 2025

Suqian, Jiangsu, April 14, 2025 – Experts and professionals gathered today at Gaoxiong Road to inaugurate the world's first pavement incorporating dual-blend recycled plastics with asphalt mixtures. With the theme of "Recycled Plastics Paving the Way for Greener Roads", the event, jointly hosted by Aramco and NEXCEL, with support from CBMA, Nanjing Tech University, and Jiangsu Suqian Traffic Engineering Construction Co., Ltd., demonstrates how waste plastics can be transformed into high-performance road construction materials. Top mainstream media in China, including Xinhua News Agency, China Daily, Global Times, China Energy News, and China Building Materials Magazine, reported on this event. Total views were more than 1 million.



NEXCEL Session Held at 79th RILEM Annual Week in Vietnam
AUG 24 2025

The 79th RILEM Week was held successfully in Hanoi, Vietnam, from August 24th to 29th 2025. Nearly 400 participants from more than 50 countries attended the conference. Dr. Li Juan, Program Director of NEXCEL, as a keynote speaker, delivered a speech titled "Sustainable solutions of concrete". Through analysis of marine engineering cases, she demonstrated how to improve the fire-resistance and creep-resistance of Fiber-Reinforced Polymer (FRP) composites in marine environments.

During the conference, NEXCEL held a special session on "Non-Metallic for Resilient Infrastructure". Six NEXCEL project teams from China and four perfessionals from UK, Israel, Vietnam and Italy were invited to deliver presentations covering multiple cutting-edge areas in the NEXCEL session.





NEXCEL Shows at 19th MECC
NOV 11, 2025

The 19th Middle East Corrosion Conference & Exhibition (MECC) was successfully held from November 11 to 13, 2025, at the Dhahran Expo Center in Saudi Arabia. NEXCEL participated as an invited exhibitor, hosting a dedicated booth to showcase 16 cutting-edge nonmetallic material products and technologies, and communicated with over 100 potential partners. During the exhibition, Aramco top management, headed by Mr. Wail A. Al Jaafari, Executive Vice President of Aramco, visited NEXCEL's booth and engaged in an exchange with NEXCEL team. At the technical program, NEXCEL teams were invited to deliver 3 presentations covering multiple cutting-edge areas.



NEXCEL 2025 Series of Forum Successfully Held
NOV, 2025

TNEXCEL organized 6 high-level technical forums focusing on cutting-edge technologies, engineering applications, and low-carbon pathways for nonmetallic materials. These forums featured presentations from 31 leading experts and NEXCEL project teams from China, Saudi Arabia, the United States, and Hong Kong, attracting over 35,000 online participants. The series fostered in-depth dialog across industry, academia, research, and application sectors, further strengthening NEXCEL's role as a central hub for knowledge exchange and innovation. The series focused on six areas:

- Forum on FRP Rebars and Application
- Forum on ECC Materials
- Forum on FRPs for Civil Engineering
- Forum on Waterproofing Materials
- Forum on Insulation Materials
- Forum on Pavement Materials





SPEECHES TO THE PUBLIC

NEXCEL Project Key Member Dr. Jin Xiaodong Gave a Presentation Entitled 'Research on Flame Retardancy and Structural Safety of Organic Insulation Materials'



The Annual Conference on Flame Retardancy was held in Huizhou, Guangdong recently. Dr. Jin Xiaodong, Associate Professor from Beijing University of Technology and the member of NEXCEL project "Develop certification for external thermal insulation composite systems (ETICS)," delivered a presentation titled "Research on Flame Retardancy and Structural Safety of Organic Insulation Materials".

NEXCEL Ph.D. Student Wang Wanfu Gave a Presentation Entitled 'Synthesis of Fe-MOF as a Synergistic Flame Retardant and Its Application in Flame-Retardant PS'



The 15th National Conference on Fire Safety Materials, organized by NingboTech University, was successfully held in Ningbo, Zhejiang, attracting over 300 experts and scholars to discuss the innovative development and applications of fire safety materials. Wang Wanfu, Ph.D. candidate from Beijing University of Technology, Principal Investigator of NEXCEL 2024 PHD project "Surface Modification of Extruded Polystyrene Foam and the Study of Its Flame Retardancy and Adhesion Performances," participated in the conference and gave a presentation on "Synthesis of Fe-MOF as a Synergistic Flame Retardant and Its Application in Flame-Retardant PS."

NEXCEL Project Key Member Dr. Chang Xiwen Gave a Presentation Entitled 'Study on Microstructure Regulation of Zeolite and its Asphalt VOCs Reduction Mechanism'



The first Transportation Technology and Industry Innovation and Development Conference was held in Suzhou. Prof. Xiao Yue, Principal Investigator of NEXCEL project TDA-3, and team members attended the conference. Dr. Chang Xiwen, the project key member, gave a presentation focusing on asphalt pavement with low environmental load, titled "Study on microstructure regulation of zeolite and its asphalt VOCs reduction mechanism" at the "Pavement Inspection and Construction" special forum.

NEXCEL Ph.D. student ZHANG Tianwei Gave a Presentation Entitled 'Preparation and Performance Investigation of Self-Healing SBS Modified Asphalt Based on Dynamic Disulfide Bonds'



The China Materials Conference 2025 was held in Xiamen International Convention and Exhibition Center, Fujian Province, China. The conference attracted over ten thousand experts and scholars. Zhang Tianwei from Wuhan University of Technology, the student of NEXCEL 2024 PHD project "Preparation and Performance of Self-healing Polymer Modified Asphalt Waterproof Membranes," delivered a presentation titled "Preparation and Performance Investigation of Self-healing SBS Modified Asphalt Based on Dynamic Disulfide Bonds" at the Ecological Building Materials session.

NEXCEL Ph.D. student YANG Bin Gave a Presentation on the 8th China-Europe Workshop on Functional Pavement



The 8th China-Europe Workshop on Functional Pavement, hosted by Harbin Institute of Technology, was successfully held in Weihai, China. The conference attracted nearly 300 participants from 53 leading universities from over 20 countries and regions to discuss the latest research findings in the field of pavement engineering. Mr. Yang Bin from the Hong Kong Polytechnic University, the student of NEXCEL 2024 Ph.D. project "Preventive Maintenance Material Design and Multiscale Characterization of its Working Mechanism for Porous Asphalt Pavement", attended the conference anddelivered a presentation titled "Multi-scale Investigation of the Working Mechanism of Preventive Maintenance Materials for Porous Asphalt Pavements".

SPEECHES TO THE PUBLIC

NEXCEL Ph.D. Student DU Yunchang Gave a Presentation in The 2025 European Chinese Students and Scholars Seminar



Mr. DU Yunchang from the University of Lille, the student of NEXCEL 2024 PHD project "Preparation of Ultra-High Ductility Cementitious Sleeper and Study on Its Static and Dynamic Properties", attended The 2025 European Chinese Students and Scholars Seminar and delivered a presentation entitled "Uniaxial and Triaxial Mechanical Behavior of High-Performance Engineered Cementitious Composites (ECC): Stress–Strain Response and Failure Characteristics".

NEXCEL Ph.D. Student ZHANG Tianwei Gave a Presentation on the 14th Youth Forum on Road and Airport Engineering Research



The 14th Youth Forum on Road and Airport Engineering Research was held in Wuhan from October 31 to November 2, 2025. The conference attracted over 600 experts and scholars. Mr. ZHANG Tianwei from Wuhan University of Technology delivered a presentation titled "Preparation and Performance Study of Self-Healing Crumb Rubber-Modified Asphalt Waterproofing Membranes" at the "Functional Resilience of Roads and Airports" session. His research titled "Preparation and Performance Study of Self-healing Polymer-modified Asphalt Waterproofing Membranes" was funded by NEXCEL.

NEXCEL Ph.D. Student Yan Dawei Gave a Presentation on the 6th National Conference on Composite Materials in Civil Engineering



Mr. DU Yunchang from the University of Lille, the student of NEXCEL 2024 PHD project "Preparation of Ultra-High Ductility Cementitious Sleeper and Study on Its Static and Dynamic Properties", attended The 2025 European Chinese Students and Scholars Seminar and delivered a presentation entitled "Uniaxial and Triaxial Mechanical Behavior of High-Performance Engineered Cementitious Composites (ECC): Stress–Strain Response and Failure Characteristics".

PARTNERSHIP

NEXCEL and HUCE Signed International Partner Agreement (IPA)
JAN 9, 2025



NEXCEL and the Hanoi University of Civil Engineering (HUCE) signed an International Partner Agreement (IPA), in order to share opportunities of research development and international cooperation in the field of nonmetallic materials. Dr. Li Juan, Program Director of NEXCEL, and Prof. NGUYEN Hoang Giang, Vice Rector of HUCE, signed this agreement on behalf of both parties. Both sides will take the IPA signing as an opportunity to establish a long-term and stable collaborative relationship. Through resource sharing, project developing, conference co-organizing, and technical application, both sides aim to advance industrial upgrading, expand market opportunity, raise public awareness, and jointly accelerate the research innovation and engineering application of nonmetallic materials in ASEAN countries.

OUTREACH

NEXCEL Visits Chang' an University
MAR 3, 2025

NEXCEL team visited Chang'an University to communicate with NEXCEL project teams of 2024 TDA project "Development and demonstration of non-metallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement" and 2022 PHD project "Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate". The exchange meeting has enabled NEXCEL to better track the progress of Chang'an University teams. Both parties will maintain regular technical coordination, promptly implement optimization adjustments for any deviations from the technical road map, while accelerating the preparations of project demonstration to ensure the orderly progression of established project milestones.



NEXCEL Visits the Production Line of Phase Change Energy Storage Particles for Asphalt Pavement
MAR 4, 2025

NEXCEL team visited Shaanxi Hancheng production base of Beijing Qintian Sci&Tech Group (QINTIAN), which is the project member of NEXCEL 2024 SFP project "Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture". Mr XU Tongyue, General Manager, Mr JIN Jiangtao, Deputy General Manager of QINTIAN, and Prof LI Haijian of CBMA introduced the production line of phase change energy storage particles with annual output of 60,000 tons. This visit deepens the cooperation between NEXCEL and project team. Both parties have committed to leveraging their strengths in phase-change particulate material production and engineering application, with the shared objective of advancing the industrialization of smart temperature-regulating pavement materials.



NEXCEL Attended CCPA Innovation Platform FORUM
APR 20, 2025

NEXCEL attended 2025 China Concrete and Cement Products Association (CCPA) Innovation Platform Forum and discussed on the long-term performance testing of FRP rebars and FRP reinforced concrete prefabricated components.



NEXCEL Visits Dextra Building Materials (Guangdong)
APR 21, 2025

NEXCEL was invited to visit Dextra Building Materials (Guangdong) and the FRP production line and the national-level certified laboratory.



NEXCEL Visits Keshun Waterproof Technology
APR 22, 2025

NEXCEL conducted a meeting with Keshun Waterproof Technology, project partner of NEXCEL TDA project "Development and engineering demonstration for thermoplastic polyolefin waterproof sheets with high flame retardancy and long service life", and visited the production line of intelligent TPO waterproofing sheets.



Prof. Victor C. Li Joined NEXCEL TAC
JUL 23, 2025

NEXCEL team visited Professor Victor C. Li, inventor of Engineered Cementitious Composites (ECC), for in-depth discussions on NEXCEL's projects on sustainable concrete, and invited Professor Victor C. Li to join NEXCEL Technical Advisory Committee(TAC). Professor Yu Jiangtao (academic leader in China's ECC research, Tongji University) and Professor Lu Zichen (NEXCEL Project Principal Investigator, Tongji University) also participated in the meeting.



OUTREACH

NEXCEL visits FRP Rebar Demonstration and Carbon Fiber Companies
JUN 12, 2025

NEXCEL team conducted an on-site inspection of the demonstration for NEXCEL 2023 TDA project "Fire Endurance and Creep Resistance Improvement for Application of GFRP Rebars" in Lianyungang, Jiangsu. The application demonstrates actual performance of FRP under salty and humid conditions, providing practical references for future technical improvement and engineering standard formulation. Following the site inspection, NEXCEL visited the project partner Zhongfu Carbon Fiber Core Cable Technology and exchanged views on engineering prospects and technical challenges for fire/corrosion-resistant GFRP rebars in coastal environments.



NEXCEL Visits Zhongfu Shenying Carbon Fiber
JUN 13, 2025

NEXCEL visited Zhongfu Shenying Carbon Fiber, a national high-tech enterprise integrating the R&D, production and sales of carbon fiber and composites. After visiting its exhibition hall and carbon fiber production line, both parties exchanged views on applying carbon fiber products in building and construction sector.



Aramco Asia VP Visited NEXCEL
SEP 11, 2025

Mr. Saad H Allowemi, Vice President of Engineering & Technical Services in Aramco Asia, visited NEXCEL, and had in-depth exchanges on NEXCEL outcomes and future development.



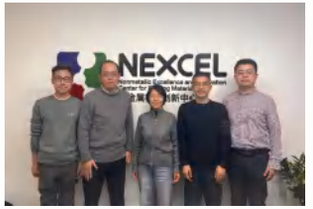
NEXCEL Team Visited Aramco in Dhahran, Saudi Arabia
NOV 10, 2025

NEXCEL team visited Aramco in Dhahran, and met with members of the NEXCEL Steering Committee and Technical Advisory Committee. The two sides held in-depth discussions focusing on NEXCEL ongoing projects, operational progress, and future development. NEXCEL team also visited Aramco Digital Center, gaining further insight into Aramco's latest achievements in digital transformation and innovative technology applications.



Tongji University Visited NEXCEL for Exchange
JAN 9, 2026

Professor YU Jiangtao, Secretary-General of the ECC Branch of CCPA and NEXCEL Technical Committee (TC) member, and Professor YU Kequan from Tongji University, visited NEXCEL to conduct technical exchanges on ECC structure design, nonmetallic fiber, construction technology, and special environment applications. During the communication, both parties reached a consensus on cooperation and will fully leverage their platform advantages to establish a long-term and stable cooperation mechanism.



China National Building Waterproof Association Visited NEXCEL
FEB 12, 2026

NEXCEL Strategic Partner, China National Building Waterproof Association (CWA) visited NEXCEL for exchange. Mr. Hu Xibao, President of CWA, Mr. Zhang Yong, TAC member of NEXCEL, Vice President and Chief Engineer of CWA, and Mr. Cheng Xiaohui, Deputy Secretary-General of CWA, as well as NEXCEL team attended the meeting. The two sides held in-depth discussions on the current research and application of waterproofing materials, NEXCEL's related projects, as well as cooperation plan for 2026 in areas such as joint promotion and participation in industry conferences.



PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
1	22TDA1-1	*Analysis-oriented model for FRP tube-confined concrete: 3D interpretation of biaxial tube behaviour*
2		*Strengthening RC beams with mid-span supporting prestressed CFRP plates: An experimental investigation*
3		*Application of ultra-lightweight and large-scale pultruded for external frame beam in high-rise buildings (in Chinese)*
4		*A binary resin system of epoxy and phenol-formaldehyde for improving the thermo-mechanical behavior of FRP composites*
5		*Non-linear behaviors of pultruded GFRP composites*
6		*Flexural performance of curved-pultruded GFRP arch beams subjected to varying boundary conditions*
7	22TDA2-4	*Rheological properties of warm mixed asphalt*
8		*Effect of warm mix agent on the chemo-mechanical performance of binder with different oil sources*
9	22TDA3-1	*Preparation and performance of EPEG-type PCE and its application in ultra-high performance concrete*
10		*Research status and prospect of domestic polyether macromonomer (in Chinese)*
11		*Research on the mix proportion of low-carbon concrete utilizing a novel polycarboxylate Superplasticizer*
12		*Research on the effect and mechanism of binder-sand ratio on UHPC performance*
13	22TDA4-1	*Comparative study of standard stroke load design of communication poles and towers in China, America and Europe (in Chinese)*
14		*Improving performance of GFRP joints using bolted/mortise-tenon hybrid method*
15	22SFP1-1	*Differences in micro grain/fiber distributions between matrix and interlayer of cementitious filaments affected by extrusion molding*
16		*Gradient distribution of slender glass microfibers in 3D printed cementitious filaments*
17		*Rebar-matrix interface in extrusion molded cementitious filaments*
18	22SFP2-1	*Research on properties of sulfoaluminate cement-based premixed fluid solidified soil curing agent (in Chinese)*
19		*Fluid solidification of construction waste soil (in Chinese)*
20	22SFP3-1	*Performance research and engineering application of in-place recycled asphalt mixture with warm mixing technology (in Chinese)*
21	22SFP4-1	*Influence of slurry characteristics on the bubble stability in foamed concrete*
22		*Process optimization study of encapsulation method for pretreatment of recycled EPS particles (in Chinese)*

PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
23	22SFP5-1	*Effects of polymer-cement ratio on the properties of polymer mortar (in Chinese)*
24		*Effect of polymer modified volcanic rock coarse aggregate on properties of concrete (in Chinese)*
25	2022PHD-1	*Mixed-alkali effect on thermal property and elastic behavior in borosilicate glasses*
26	2022PHD-2	*Impacts of asphalt and mineral types on interfacial behaviors: A molecular dynamics study*
27		*Interfacial performance of asphalt-aggregate system under different conditions based on molecular dynamics simulation*
28		*Comprehensive evaluation of ballastless-track sealants based on macro–micro tests and principal component analysis*
29	2023TDA1-1	*Improving the interfacial properties of PVA fiber and cementitious composite: Design and characterization*
30		*A Two-Step Synthesis of Porous Nitrogen-Doped Graphene for Electrochemical Capacitors*
31		*Impact of C-F-S-H/PCE Nanocomposites on Hydration and Mechanical Properties of Slag Cement (in Chinese)*
32	2023TDA2-2	*Performance of thermal-oxidative aging on the structure and properties of ethylene propylene diene monomer (EPDM) vulcanizates*
33		*Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*
34	23TDA3-2	*Experimental study on seismic performance of two-story two-bay. Precast concrete frame with UHPC-based connections*
35		*Out-of-plane response of prefabricated concrete shear walls connected via grouted sleeves*
36		*Calculation method for heat transfer coefficient of ribbed composite insulated exterior wall panels*
37	23TDA3-2	*Experimental research on shearing behavior of connectors in precast sandwich insulation wall panel*
38		*Experimental research on anchoring performance of connectors in precast sandwich insulation wall panel*
39		*Finite element analysis of stress performance of precast concrete multi-ribbed sandwich insulation facade panel*
40	23TDA4-1	*Strength retention rate distribution model and reliability analysis of FRP stirrups (in Chinese)*
41		*Shear behavior of two-span continuous concrete deep beams reinforced with GFRP bars*
42		*Calculation method of the flexural tensile strength of the GFRP stirrups based on the database (in Chinese)*
43		*Transfer learning-based confinement strength prediction of concrete confined by FRP transverse reinforcements*

PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
44	23TDA4-1	*Flexural Behavior and Design of Ultrahigh-Performance Concrete Beams Reinforced with GFRP Bars*
45		*Experimental Investigation on Pure Torsion Behavior of Concrete Beams Reinforced with Glass Fiber-Reinforced Polymer Bars*
46		*A modified softened truss model and strength prediction formula for fiber-reinforced polymer reinforced concrete members under pure torsion*
47	23TDA5-1	*Experimental investigation on post-fire mechanical properties of glass fiber-reinforced polymer rebars*
48		*Static and fatigue behavior of CFRP strengthened spiral welded steel tubes subjected to four-point bending*
49		*Novel adaptive prestressed CFRP-reinforced steel column: Concept and behavior*
50		*Novel high-temperature resistant GFRP bars with DOPO-modified vinyl ester: Design, performance, and application*
51		*Long-term Behavior of High Performance GFRP Bars, International Conference on Advances in Engineering and Technology for sustainable development*
52		*High-temperature mechanical properties of GFRP bars Experimental database and novel degradation models*
53	23TDA6-2	*Mechanical performance of polymer-modified mortar with the newly designed gradient structure: effect of polymer types and content*
54		*Research progress on concrete-polymer composites*
55	23TDA6-2	*The influence of gradient change in polymer content on the properties of cement mortar*
56		*Research on gradient-enhanced polymer-modified concrete for structural use and comparison with conventional concrete*
57		*A new method to improve the crack resistance of cement-based composites: Development of magneto-responsive polymer latex and performance evaluation*
58		*Effect of styrene acrylic latex on the performance of metakaolin blended cement: From hydration to mechanical properties*
59	23SFP1-2	*Microscopic properties of asphalt and polyethylene at an extraordinary high dosage through molecular dynamics simulation*
60		*Preparation method and properties of high viscosity and elasticity road asphalt modified with recycled low-density polyethylene plastic at a large dosage (in Chinese)*
61	23SFP4-1	*Protective and flame retardant bifunctional epoxy-based-nanocomposite coating by intercomponent Synergy between Modified CaAl-LDH and rGO*
62		*Preparation of tung oil microcapsules and their self-healing properties (in Chinese)*
63		*Preparation of graphene oxide/aluminum hypophosphite hybrids and the improvement on flame retardancy in PC/ABS (in Chinese)*

PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
64	23PHD-1	*Novel bamboo-raft-type floating structure (BRT-FS) assembled by FRP reinforced concrete tubes: Conceptual design and analysis*
65		*Mesoscale simulation method for preplaced aggregate concrete based on physics engine*
66	23PHD-6	*Modification of early-age microstructure and enhanced mechanical properties of cement paste via injecting low-dose CO^2 at fresh stage*
67		*Effect of CO^2-mixing dose and prolonged mixing time on fresh and hardened properties of cement pastes*
68	23PHD-8	*Experimental investigation on transverse tension-tension fatigue behavior of pultruded GFRP unidirectional lamina*
69		*Prediction of fatigue crack propagation in center cracked steel plate strengthened with partially covered CFRP strip*
70		*Probabilistic fatigue stiffness variation of angle-ply GFRP composites considering stress ratio effect*
71	24TDA-1	*Effects of aggregates and fibers on the strength and permeability of concrete exposed to low vacuum environment*
72		*Hydration and microstructure evolution of cement paste in low vacuum environments*
73		*Regulating drying shrinkage behavior of cement-based materials in low vacuum environments and developing a predictive model*
74		*Acoustic emission-based flexural fracture analysis of polyethylene fiber reinforced ultra-high performance concrete under low vacuum environment*
75		*Enhancing Concrete Performance in Low Vacuum Environments: Strategies and Mechanisms*
76	24TDA-2	*Hydrophobic Phenolic/Silica Aerogel Composites with High Fire Safety and Strength for Efficient Thermal Insulation*
77		*Recent Advances in Inorganic Hybrid Phenolic Aerogels*
78	24TDA-4	*Preparation of waterborne polyurethane-modified trackless emulsified asphalt and its road performance*
79		*Degradation mechanism and performance of polyurethane mixture under water conditions*
80		*Study on the road performance and development mechanism of polyurethane binder in different media solutions*
81	24TDA-5	*External thermal insulation composite systems (ETICS) supplier and its certification method*
82		*Research on the influencing factors of the compatibility index of the exterior insulation system (ETICS) of the thin plastered exterior wall*
83	24SFP-2	*Seismic behavior of full-scale PEN FRP-concrete-steel double skin tubular columns*
84		*Seismic performance and shear strength of HECC/RC beam-column joints with simplified reinforcement*

PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
85	24SFP-2	*Seismic performance of short concrete columns reinforced with steel-FRP composite bars and GFRP stirrups*
86		*Seismic Performance of Embedded GFRP Tube-Concrete Composite Exterior Beam-Column Joints*
87	24SFP-3	*A practical method for testing the properties of phase change materials and composites*
88	24SFP-4	*Effect of fiber surface treatment with silane coupling agents and carbon nanotubes on mechanical properties of carbon fiber reinforced nylon 6 composites*
89		*Study on the durability of compression behavior for glass fiber-reinforced polypropylene thermoplastic composite bars in various aging environments*
90		*Design, preparation and mechanical properties of novel glass fiber reinforced polypropylene bending bars*
91		*Long-term properties evolution and life prediction of glass fiber reinforced thermoplastic bending bars exposed in concrete alkaline environment*
92	24SFP-5	*Investigation on physical, rheological properties and VOCs emission of asphalt modified with hydrocarbon-based graphene*
93	24PHD-1	*Optimization design of asphalt emulsion with rejuvenator towards a uniform distribution inside the damaged porous asphalt mixture for a better ravelling resistance*
94		*Maintenance mechanisms of rejuvenator-optimized asphalt emulsion in damaged porous asphalt mixture: Morphological, physicochemical, and rheological characterizations*
95	24PHD-2	*Investigating the role of sulfur stabilizer in modulating aging properties of SBS-modified asphalt*
96		*Evolution of Phase Structure and Mechanical Properties in Aged SBS-Modified Asphalt*
97	24PHD-3	*Recycling of wind turbine blade powder into HDPE wood-plastic composites: Enhanced mechanical and flame-retardant properties via interfacial modification*
98		*Self-assembled coatings with durable flame retardancy for EPS foam*
99	24PHD-4	*Multifunctional phosphorus-containing imidazoliums endowing one-component epoxy resins with superior thermal latency, heat resistance, mechanical properties, and fire safety*
100		*Development of single-component epoxy resin with superb thermal stability, flame retardancy, smoke suppression, and latency via Cu-based phosphorus/imidazole-containing complex*
101		*Phosphorus-derived imidazolium salts with varied oxidation states: Tailoring latency, mechanical properties, and flame retardancy in single-component epoxy resins*

PUBLICATIONS 2022 - 2025

No.	Project No.	Paper Name
102	24PHD-5	*A pull-out equivalent telescopic layered failure model of carbon fiber bundles in seawater sea-sand cementitious matrix*
103		*Effect of ICCP on tensile performance and piezores effect of CFRCM plates*
104		*Effect of ICCP on bond performance and piezoresistive effect of carbon fiber bundles in cementitious matrix*
105		*Effect of ICCP on tensile performance of carbon fiber bundles in seawater sea-sand cementitious matrix*
106	24PHD-6	*Effect of shear connection degree on static behavior of externally prestressed FRP-concrete hybrid beams: Experimental and numerical study*
107	24PHD-7	*Development of sustainable desulfurized waste crumb rubber modified asphalt with enhanced self-healing properties*
108		*Effect of aging on structure and properties of self-healing-enhanced SBS modified asphalt with dual dynamic chemical bonds*
109		*Effect of dynamic disulfide bonds on microstructure, storage stability, and self-healing performance of desulfurized waste crumb rubber–modified asphalt*
110	24PHD-8	*Recent advances in monomer-in-situ polymerization modified cement-based materials*
111	24PHD-10	*Design of microwave absorbing frequency bands and selection criteria for vitreous aggregates in cement-based materials*
112		*Effects of Coal Gas Fine Ash on Electromagnetic Properties of Cement Mortar and Carbon Black Modification*

PATENTS 2022 - 2025

No.	Project No.	Status	Patent No.	Patent Name
1	22TDA1-1	Filed		*A fire- and flame-retardant pultruded fiber reinforced composite and its manufacturing method*
2		Granted	ZL202320009061.9	*A fire-retardant pultruded fiber reinforced composite profile*
3		Filed		*An anchoring device for clamping carbon plates and its method of use*
4		Granted	ZL202421047061.9	*An anchoring device for clamping carbon plates*
5		Granted	ZL202421061732.7	*A carbon fiber composite plate stay cable*
6		Filed		*A carbon fiber composite plate stay cable*
7		Filed		*A strengthening device and strengthening method*
8		Filed		*A strengthening device*
9	22TDA2-4	Filed		*Activator for in-place foamed warm regeneration mixture, foamed warm regeneration mixture and its preparation method*
10	22TDA3-1	Filed		*An ultra-high dispersed water reducer and its preparation method*
11		Filed		*An ultra-high dispersed water reducer and its preparation method*
12		Granted	ZL202310596973.5	*A hyperbranched polyether and its preparation method*
13		Granted	ZL202310596949.1	*An ultra-highly dispersing polycarboxylate superplasticizer and its preparation method*
14	22TDA4-1	Filed		*A washboard corner composite profile, forming tooling and preparation method, application*
15	22SFP1-1	Filed		*Micro vibration method and 3D printing of concrete components*
16		Filed		*Preparation method and application of polymer emulsion*
17	22SFP2-1	Granted	ZL202310753459.8	*A special dispersant for soil stabilizing admixture and its preparation method and application*
18		Granted	ZL202310260905.1	*Anti-washout stabilizing admixtures for Solidification of underwater sludge and its preparation method and application*
19	22SFP3-1	Filed		*A kind of hot-in-place recycled asphalt mixture with warm-mixed technology and its preparation method*
20	22SFP4-1	Filed		*The invention relates to a pretreatment method for EPS particles and a preparation method for EPS particles foamed concrete*
21	22SFP5-1	Granted	ZL202223501265.9	*One mixing and filtering machine for polymer mortar modified coarse aggregate*
22	23TDA1-1	Filed		*Conductive cementitious materials based on modified aggregate coated graphene and their preparation method*
23	23TDA2-2	Filed		*A TPO composite waterproof membrane*

PATENTS 2022 - 2025

No.	Project No.	Status	Patent No.	Patent Name
24	23TDA2-2	Filed		*A waterproof roll material*
25	23TDA3-2	Filed		*A thermal insulation wall connector*
26	23TDA4-1	Filed		*A device and process for producing FRP stirrups*
27	23TDA5-1	Filed		*Modification of vinyl ester resin and preparation method thereof*
28	23TDA6-2	Filed		*A device and construction method for concrete pavement based on an imposed magnetic field*
29	23SFP1-2	Granted	ZL20232097178.4	*A type of miscible storage device for waste plastic modified asphalt*
30		Granted	ZL20232097182.0	*A device for preparing waste plastic modified asphalt*
31	23SFP4-1	Filed		*Preparation method and application of flame-retardant and self-healing epoxy-based or polyurethane-based composite coatings*
32	23PHD-1	Filed		*Raft-type Platform with Photovoltaic and Wave Power Generation System*
33	24TDA-1	Filed		*A highly stable concrete in low vacuum tube environments and its preparation method*
34		Filed		*An epoxy resin-based composite coating, coating layer, and preparation method adapted for low-vacuum environments*
35	24TDA-2	Filed		*A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method and application*
36		Filed		*A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method, application*
37	24TDA-4	Filed		*A method for evaluating the degree of curing of polyurethane mixes for road use*
38		Filed		*A modeling method of molecular dynamics model for a kind of road single-component polyurethane adhesive*
39	24SFP-2	Granted	ZL202411859045.4	*A beam-column joint reinforced with FRP tubes*
40		Granted	ZL202411857656.5	*A novel composite structure of FRP tubes and concrete*
41	24SFP-3	Granted	ZL202510369225.2	*A method and device for testing the thermal performance of plate-like phase change energy storage components*
42	24SFP-4	Filed		*New bending device for fiber reinforced thermoplastic composite stirrups*
43		Filed		*Bending forming device for thermoplastic fiber reinforced composite stirrups and manufacturing method*
44		Filed		*New bending device and forming method for fiber reinforced thermoplastic composite stirrups*
45	24SFP-5	Filed		*Hydrocarbon-based graphene modified asphalt and its preparation method*
46		Filed		*A kind of mixing and stirring device*

STANDARDS 2022 - 2025

No.	Project No.	Status	Standard Name
1	22TDA1-1	Issued (T/CSTM 01345-2024)	Code of technical practice for FRP composite cooling tower structures
2	22TDA2-4	Draft for Review	Technical specification for mechanically foamed warm mix asphalt
3	22TDA4-1	Draft for Review	Specification for the manufacture of composite lattice towers for communication
4	22SFP1-1	Draft for approval	Test method for interfacial bonding strength of 3D-printed cement-based materials
5	22SFP3-1	Issued (T/CHTS 10137-2024)	Technical guide for hot in-place recycling clean construction of asphalt pavement
6	23TDA2-2	Issued (T/CECS 10374-2024)	Pre-applied butyl polymer waterproofing membrane
7	23SFP1-2	Draft for Review	Technical specification for application of recycled plastic filler for asphalt mixture
8	23SFP2-1	Draft for Review	Thermoplastic fiber-reinforced polymer composite bar
9	23SFP3-2	Draft for Review	Recycled plastics for building plastic formwork
10	23SFP4-1	Issued (T/CSCP 0003-2023)	Self-healing performance evaluation methods of organic coating

STANDARDS 2022 - 2025

No.	Project No.	Status	Standard Name
1	22TDA1-1	Issued (T/CSTM 01346-2025)	Test method for tensile properties for pultruded fiber reinforced polymer composites — End-pushing clamp method
2	22TDA3-1	Draft for Approval	Polyether and its derivatives for concrete admixtures
3	23TDA1-1	Draft for Review	Graphene for cement and concrete
4	23TDA3-2	Issued (GB/T 46826-2025)	Technical requirements for integrated load-bearing and insulation wall panels and connecting accessories in low-rise and mid-rise rural housing
5	23TDA3-2	Draft for Review	Technical specification for connectors in precast concrete non-composite insulated sandwich wall panels
6	23TDA4-1	Draft for Review	Fiber reinforced polymer stirrups
7	23TDA6-2	Draft for Review	Technical specification for polymer modified concrete pavement application
8	24TDA-4	Issued (T/CSTM 01345-2024)	Specifications for design of polyurethane mixture for road
9	24SFP-2	Draft for Review	Technical guidelines for composite RC joint structures with FRP (fiber-reinforced polymer)-tubed concrete core columns
10	24TDA-5	Draft for Approval	Requirements of certification for external thermal insulation composite systems

DEMONSTRATIONS 2022 - 2025

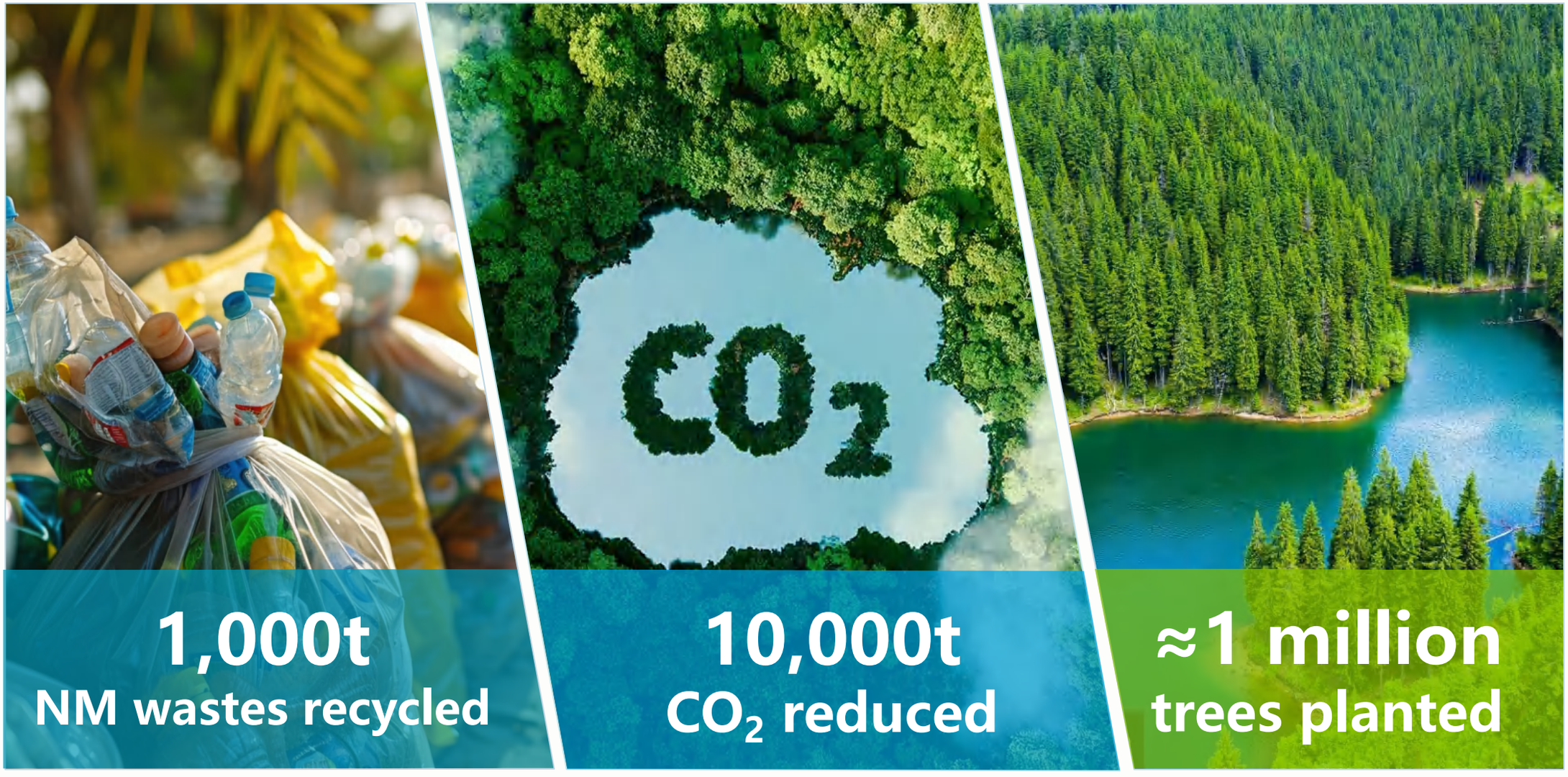
No.	Project No.	Focused Area	Time for Completion	Name
1	22TDA1-1	FRPs	2023	Pultruded GFRP External Frame Beam for High-rise Building in Qingdao
2	22TDA2-4	Pavement for road & bridges	2023	Foam Warm Mix Asphalt Technology Successfully Applied in Anhui Wuyue Expressway
3			2023	Mechanical Foaming Warm Mix Asphalt Pavement in Xin Jiang G216 Expressway
4	22TDA3-1	Construction chemicals	2023	Pilot Production of Novel Polyether Macromonomer
5			2023	Ultra-highly Dispersing PCE for UHPC Applied to Moshuihe Bridge in Shandong
6			2024	Ultra-highly Dispersing PCE for UHPC Applied to Xiaoqinghe Grand Bridge in Shandong
7			2024	Ultra-highly Dispersing PCE Applied to the Underground Pipelines in Dezhou, Shandong
8	22TDA4-1	FRPs	2023	FRP Composite Lattice Tower Built in Egypt
9			2024	FRP Composite Lattice Tower Built in Guangdong
10	22SFP1-1	Special mortars & concrete	2023	3D Printing Polymer Modified Concrete for Landscape Water Wall
11	22SFP2-1	Construction chemicals	2023	Admixtures for Solidified Soil Applied to Fabricated Building
12	22SFP3-1	Pavement for road & bridges	2023	In-place Recycling of Waste Asphalt Pavement in Baotou-Maoming Expressway
13			2023	In-place Recycling of Waste Asphalt Pavement in Shanghai-Shaanxi Expressway

DEMONSTRATIONS 2022 - 2025

No.	Project No.	Focused Area	Time for Completion	Name
14	22SFP4-1	Insulation & composite cladding	2023	Recycled EPS/foamed Concrete in Composite Sandwich Panel Applied to Fabricated Buildings
15	22SFP5-1	Special mortars & concrete	2023	Polymer Modified Inferior Coarse Aggregate Applied to Concrete Sleepers
16	23TDA1-1	Special mortars & concrete	2025	Graphene concrete applied in the renovation project of the hazardous building
17	23TDA2-2	Waterproofing & repair materials	2024	TPO Waterproofing Membrane in Western (Chongqing) Science City
18	23TDA3-2	Insulation & composite cladding	2024	PIR Insulation Material Applied to Ultra-low Energy Buildings in Beijing
19		Insulation & composite cladding	2025	FRP Connectors and PIR Insulation Material Applied to Ultra-low Energy Buildings in Beijing
20	23TDA4-1	FRPs	2024	FRP Rebars Applied to Lach Huyen Port in Vietnam
21		FRPs	2025	GFRP rebars applied in coastal retaining wall in waterfront area of barka in Oman
22		FRPs	2025	GFRP Rebars-concrete fence applied to sea dam renovation project in Lianyungang
23		FRPs	2025	GFRP rebars applied to an experimental pool in Jiangsu
24	23TDA5-1	FRPs	2025	High-performance GFRP bars applied in coastal industrial construction
25	23TDA6-2	Special mortars & concrete	2024	Gradient Reinforced Polymer Modified Concrete Applied to Shanghai Outer Ring Road
26		Special mortars & concrete	2025	Gradient reinforced polymer modified concrete applied to Anyang-Hebi Highway

DEMONSTRATIONS 2022 - 2025

No.	Project No.	Focused Area	Time for Completion	Name
27	23SFP1-2	Pavement for road & bridges	2024	Asphalt Mixtures Incorporating Large Amount of Recycled Plastics Applied to the Road Reconstruction Project
28	23SFP3-2	Construction chemicals	2024	Waste Plastics Applied to Building Formwork in Xuchang, Henan
29	24TDA-1	FRPs	2025	Fiber-reinforced special concrete for low vacuum pipelines applied in the "Ultra-high-speed low-vacuum pipeline maglev transportation system test platform" in Beijing
30	24TDA-2	Insulation & composite cladding	2025	Polymer-based aerogel composites applied in building insulation engineering
31	24TDA-4	Pavement for road & bridges	2025	The polyurethane pavement applied in the urban road project in Jinan
32	24SFP-2	FRPs	2025	FRP tube-concrete composite joint structure applied in Beijing Lize demonstration project
33	24SFP-3	Pavement for road & bridges	2024	A Production Line of Phase Change Energy Storage Composite Particles for Asphalt Pavement
34		Pavement for road & bridges	2025	Phase change material applied to Meitai Highway in Shaanxi
35	24SFP-4	FRPs	2025	Thermoplastic composite bar reinforced concrete prefabricated longitudinal beams in Dayangshan offshore base project
36		FRPs	2025	Thermoplastic FRP rebars applied to Fuzhou Port



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