Funded by the European Union

Recycling Construction Waste for Cost Reduction and Efficiency Improvement

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Reconmatic

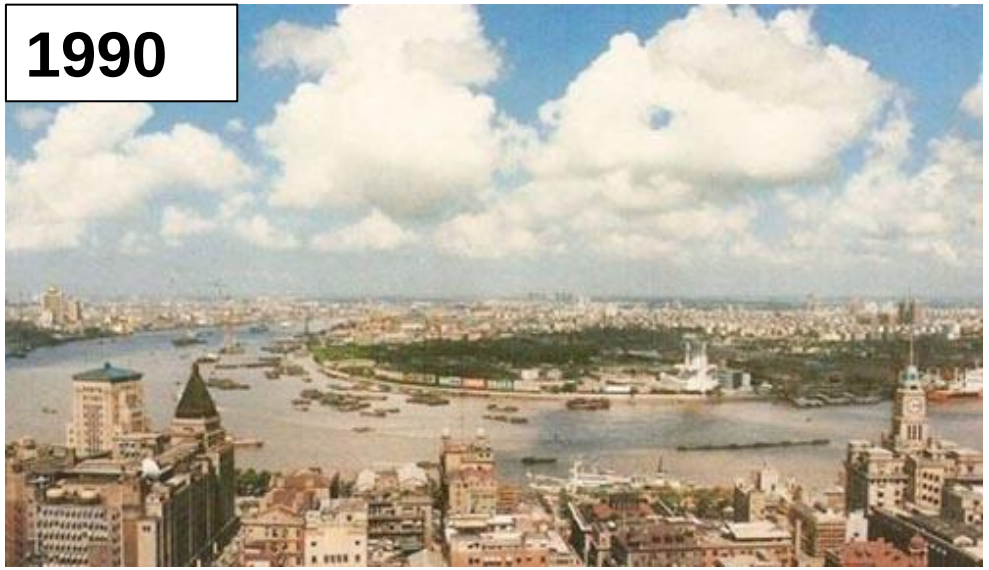
CONTENTS

PART 01

By-products from Urban Development

CABR

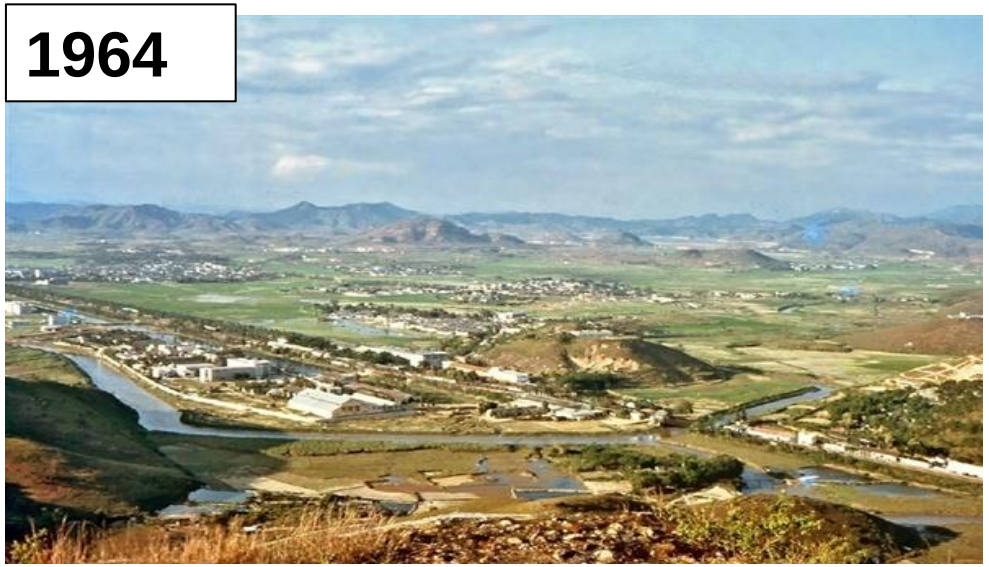
1990



2010

Shanghai

1964



Shenzhen

Research Significance

- Construction waste is a by-product of urban construction and renovation processes, with a large amount of direct and potential construction waste generated during Construction.
- It is an inevitable product of human's endless pursuit of material life and the limited lifespan of engineering projects and geographical resource constraints, resulting from social demand and technological progress. In 1978, the per capita urban housing was only 6.7 square meters, while in 2018, it was nearly 40 square meters. The shift from multi-story to high-rise buildings and the construction of underground projects have led to a significant increase in construction waste.
- It is an issue that will inevitably become prominent and must be addressed as cities develop to a certain stage and scale.

City Surrounded by Waste


Resource Waste


Environmental Pollution


Safety Hazards

Definition of Construction Waste

Construction Waste

Construction Waste includes:

Soil, discarded materials and other solid waste generated by construction units and construction companies during the construction, renovation, expansion, and demolition of various buildings, structures, pipelines, etc., as well as by residents during the decoration and renovation of houses. (engineering spoil, engineering slurry, engineering waste, demolition waste and renovation waste)

Material Composition:

Concrete blocks, gravel, brick fragments, waste mortar, slurry, earth, waste plastic, waste metal, waste bamboo and wood, etc.

Construction Waste Output (Five Categories Estimate, Unit: Billion tonns)

2018年		2019年		2020年		2021年	
35 pilot cities	Nation wide	35 pilot cities	Nation wide	35 pilot cities	Nation wide	35 pilot cities	Nation wide
13.15	24.5	13.69	25.24	14.1	26	14.5	26.9

Resource Utilization Rate: Demolition and construction waste resource utilisation rate is less than 40%, **and renovation waste resource utilisation rate is less than 10%.**

- As of 2015 end, the total urban area nationwide was 63.898 million mu. (1 **mu** = 666.67 **square meters)**
- Even if calculated at 1.5 billion, one year of stacking would occupy more than 300,000 mu.
- If construction waste is always buried and piled up, in about 200 years, the urban land in our country will be covered by construction waste!

Policy Trends

2016 — State Council: „Several Opinions on Further Strengthening Urban Planning, Construction, and Management“, for the first time clearly proposed: Strive to establish a construction waste recycling and reuse system in about 5 years

2017 — National Development and Reform Commission, Ministry of Finance, Ministry of Housing and Urban-Rural Development: 'Guiding Opinions on Promoting the Construction of Resource Recycling Bases', by 2020, approximately 50 resource recycling bases should be established nationwide

2018 — National Ministry of Housing and Urban-Rural Development: „Notice on Carrying Out Pilot Work on Construction Waste Management“, listed 35 cities nationwide as pilot cities for construction waste management

2020 — The new „Solid Waste Law“, for the first time, independently manages „construction waste“, which is conducive to the independent management of construction waste in various fields

2020 — National Ministry of Housing and Urban-Rural Development: „Guiding Opinions on Promoting the Reduction of Construction Waste“ requires: By the end of 2020, mechanisms for reducing construction waste should be initially established in various regions

2020 — Ministry of Industry and Information Technology, Ministry of Housing and Urban-Rural Development: The release of the two drafts „Normative Conditions for the Resource Utilization of Construction Waste“ and „Management Measures for the Announcement of Normative Conditions for the Resource Utilization of Construction Waste“ has greatly promoted the development of resource utilization of construction waste in our country.

2021 — National Development and Reform Commission: „The 14th Five-Year Plan for Circular Economy Development“ aims to achieve a comprehensive utilization rate of construction waste of 60% by 2025.

2022 — State Council: 'The Notice on the Guiding Opinions on Accelerating the Construction of Urban Environmental Infrastructure,' requires strengthening the fine classification and resource utilization of construction waste, improving the quality of recycled products from construction waste, expanding the scope of use, and standardizing the collection, storage, transportation, utilization, and disposal of construction waste.

PART 02

How to Solve Construction Waste

CABR

Standard Setting

National Standards:

Recycled Fine Aggregate for Concrete and Mortar (GB/T 25176), Recycled Coarse Aggregate for Concrete (GB/T 25177), Lightweight Aggregate Concrete Small Hollow Block GB/T 15229, Ecological Design Product Evaluation Specification Part 4: Inorganic Lightweight Board GB/T 32163.4

Industry Standards:

Recycled Micro Powder for Concrete and Mortar JG/T 573-2020, Technical Specification for Application of Recycled Aggregate JGJ/T240, Inorganic Mixture of Recycled Aggregate from Construction Waste for Road JC/T 2281-2014, Solid Brick of Recycled Aggregate from Construction Waste JG/T 505-2016, Technical Standard for Recycled Concrete Structure JGJ/T 443-2018

Beijing Local Standards:

"Technical Regulations for Resource Utilisation and Separation of Renovation Waste"、"Technical Specifications for the Removal and Recycling of Insulation Materials in Building Energy Efficiency Renovation"、 "Technical Specifications for the Removal and Recycling of Insulation Materials in Building Energy Efficiency Renovation"

中国工程建设标准化协会标准《装修垃圾精细化分选技术规程》审查会议

住房和城乡建设部科技与产业化发展中心
(住房和城乡建设部住宅产业化促进中心) 文件

建科中心函[2021]38 号

关于邀请参与编制中国工程建设标准化协会标准《建筑装修垃圾处置技术规程》的函

各有关单位：

根据中国工程建设标准化协会《关于印发<2020 年第二批协会标准制订、修订计划〉的通知》（建标协字〔2020〕23 号）的要求，由我中心联合中国建筑科学研究院有限公司主持编制 CECS《建筑装修垃圾处置技术规程》，现拟邀请行业内相关单位参加该标准的编制工作。具体要求如下：

1. The first domestic standard for renovation waste, the "Technical Regulations for Fine Sorting of Renovation Waste", has passed the review
2. The first domestic standard for rapid detection of soil pollution, the "Intelligent Online Detection Standard for Harmful Substances in Soil", has been launched
3. The first domestic green factory evaluation for construction waste disposal sites

➢ **11th Five-Year Plan:**

National Science and Technology Support Program 'Research on Standards for Recycled Aggregate and Recycled Concrete', 2006BAJ02B05

➢ **12th Five-Year Plan (Project):**

'Safety Control and Evaluation Technology for Recycled Building Materials from Solid Waste', 2011BAJ04B05-06 (Huaxia First Prize)

'Key Technology Research on the Durability of Recycled Concrete from Construction Waste', 2011BAJ04B05-01

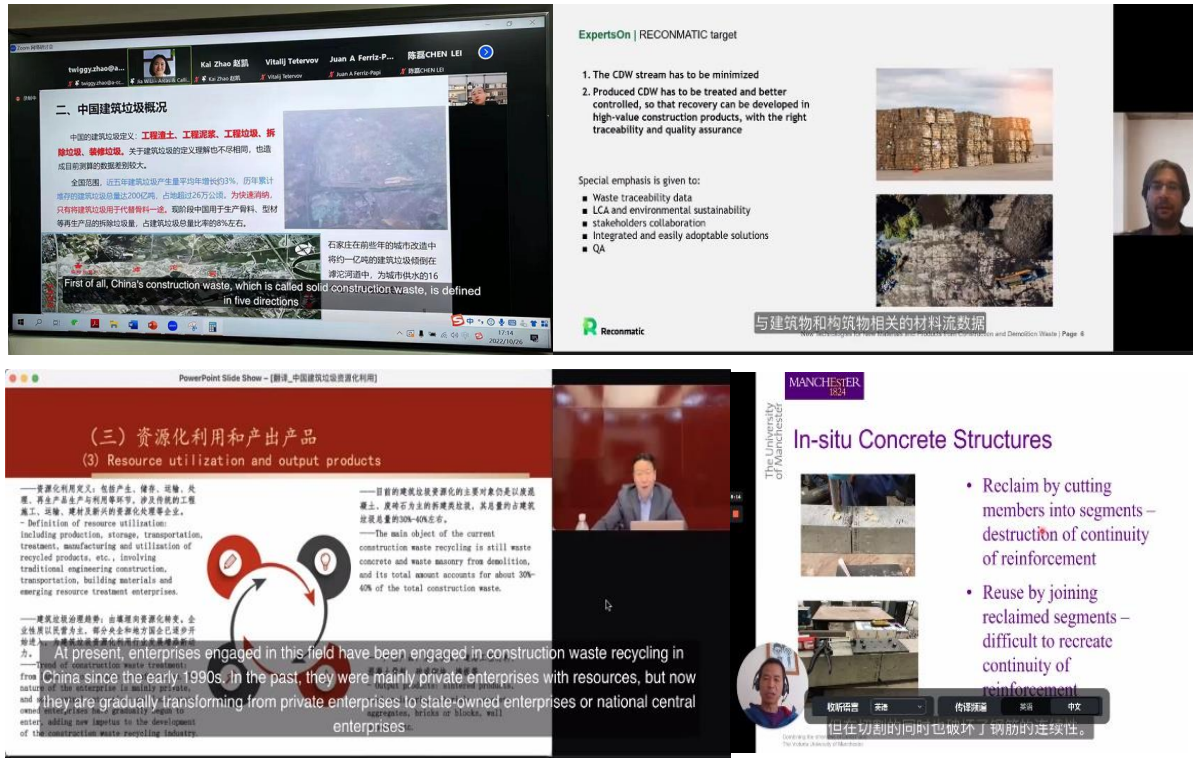
'Research on High-Efficiency Flame-Retardant Insulation Materials and Supporting Wall Insulation Systems', 2011BAJ04B03-02

➢ **13th Five-Year Plan:**

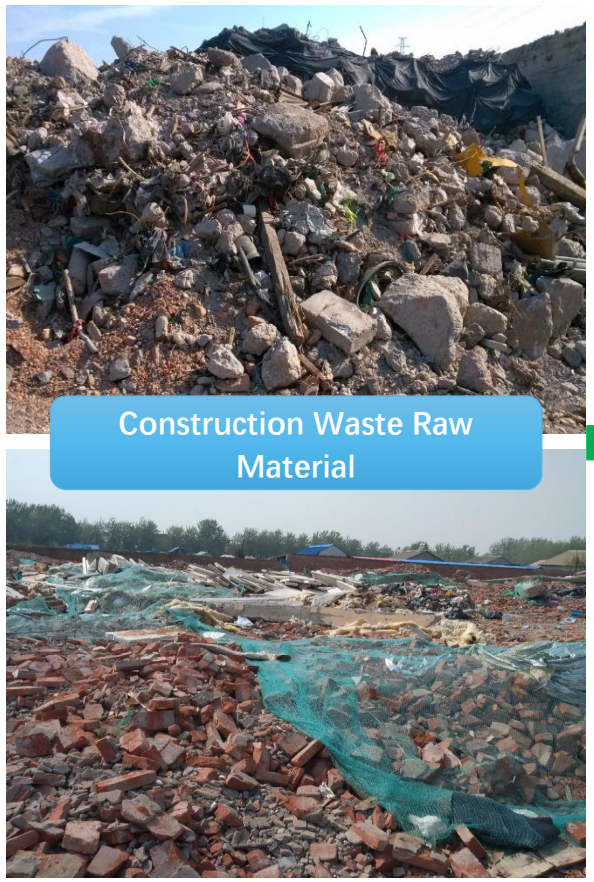
'Development of a Full Life Cycle Environmental Impact Database for Typical Functional Decorative Materials' (Huaxia Third Prize)

➢ **14th Five-Year Plan:**

Multilateral Intergovernmental Cooperation Project, EU Horizon Project 'Key Technology Research on Sustainable and Circular Construction Waste Management Solutions (RECONMATIC)'

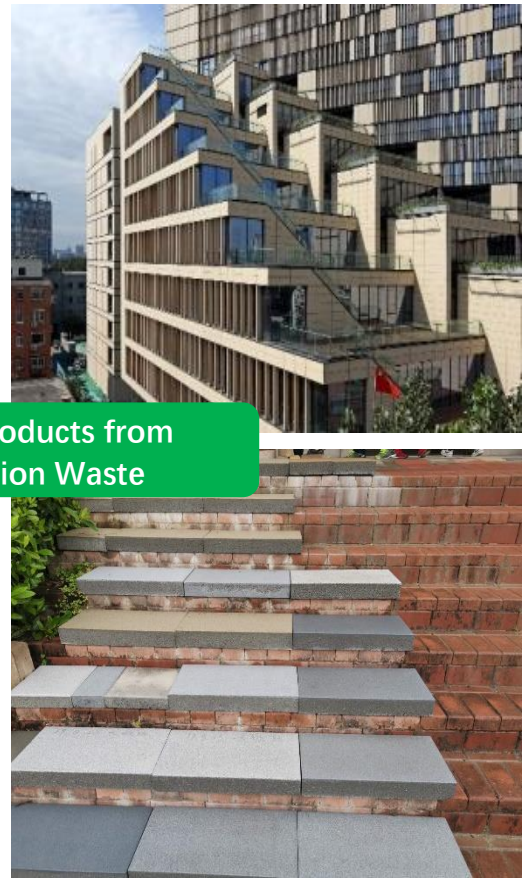


Construction Waste Recycling: Construction Waste → Recycled Building Material Products



Construction Waste Raw Material

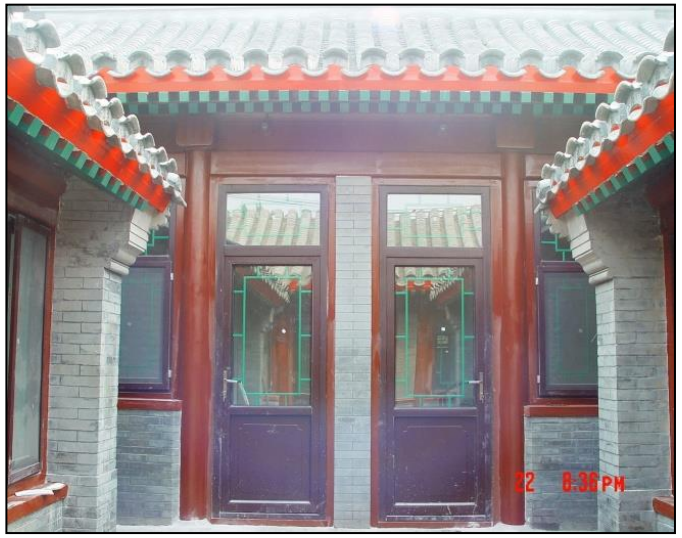
Recycled Aggregate from Construction Waste

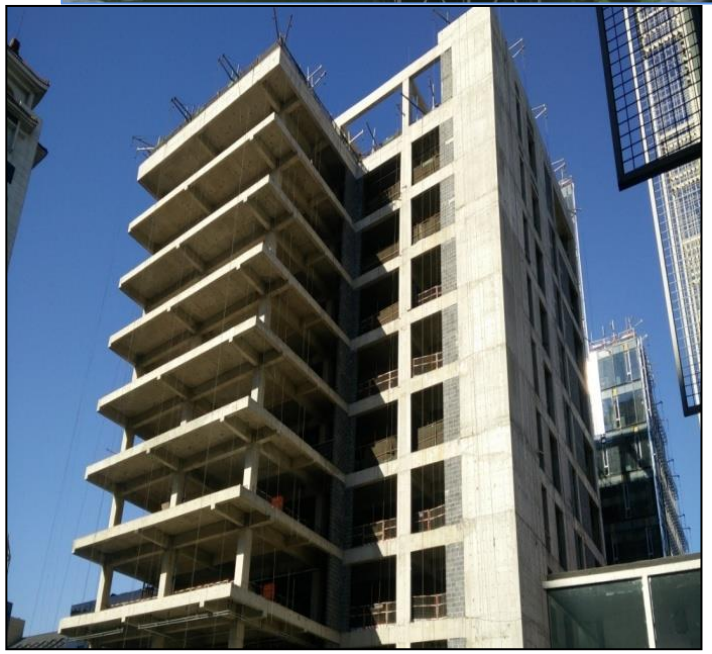


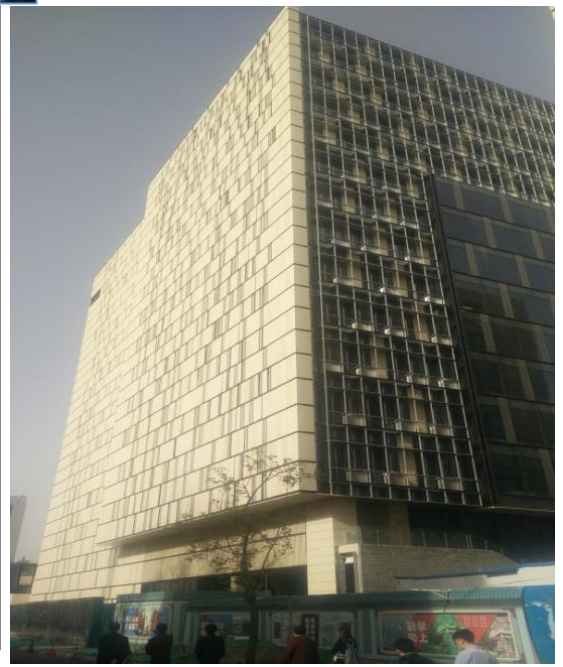
Recycled Products from Construction Waste

Recycled Products from Demolition Waste

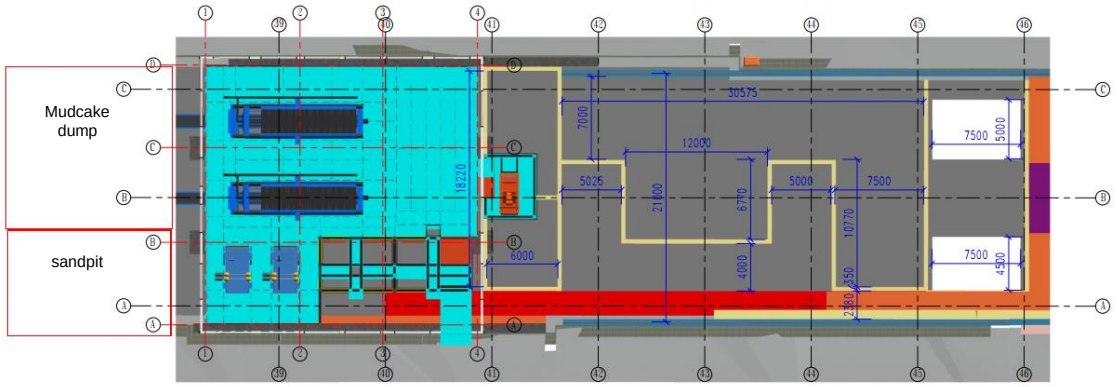
Engineering Application

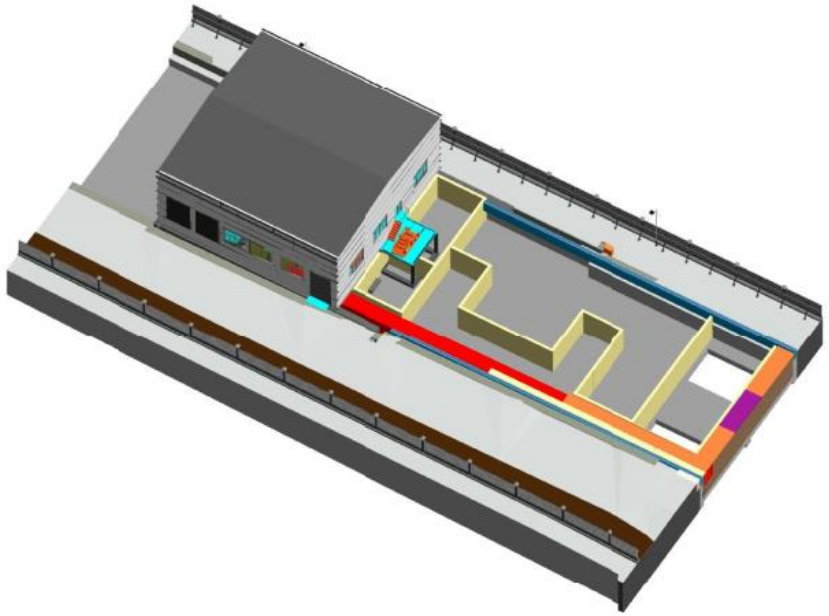


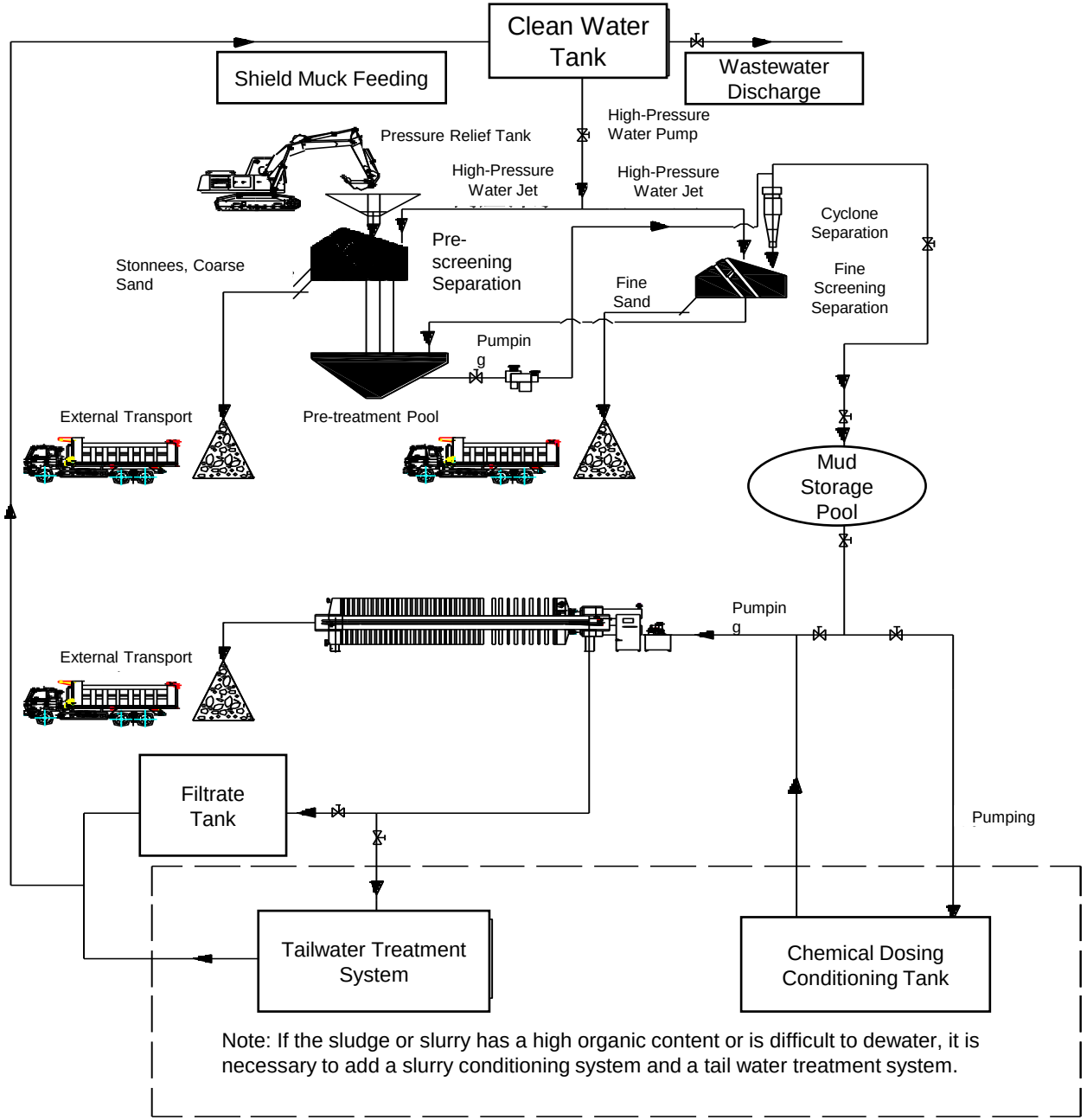




Targeting Engineering Spoil and Engineering Sludge







Recycled Wasted Soil Products

Treatment Effect

Gravel

1. Low moisture content;
2. Clean gravel without residual mud;
3. High-strength gravel can be directly used for concrete mixing.

Fine Sand

1. Mud Content: ≤ 4% ;
2. Low moisture content;
3. Clean fine sand without impurities;
4. High economic added value.

Mud Cake

1. Moisture Content: ≤ 25% ;
2. Mud cake without sand;
3. High strength, can be used for roof backfill after slight drying.

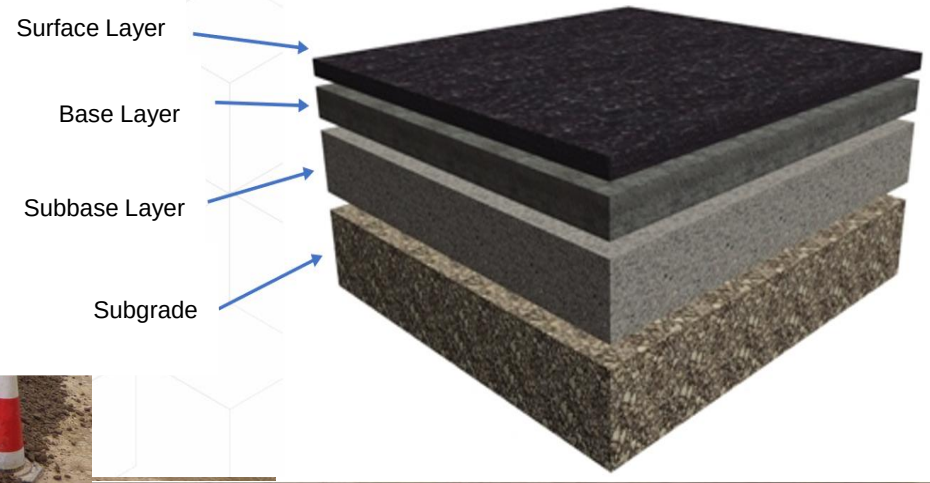
Filtrate

1 、 SS： ≤ 20 ;
2 、 PH∈ （7~8.5）；
3. Recycled filtrate reuse.

2024/11/18

Engineering Application


Ordinary Subgrade Treatment

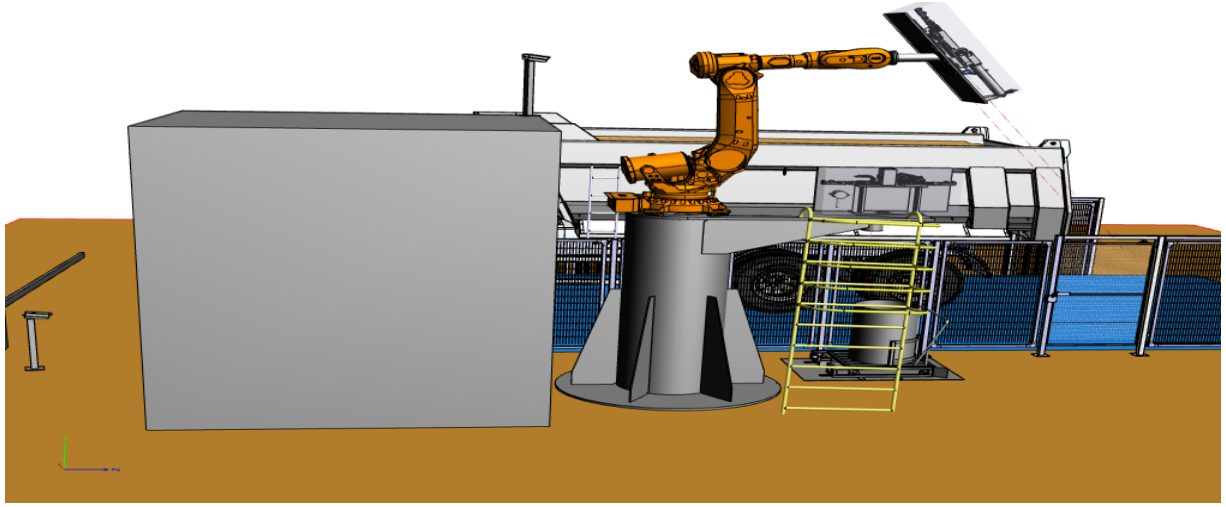



Land Reclamation


Wall Materials

Supervision of Construction Waste

Automated Soil Detection 2.0 System



The second-generation detection system was developed in 2021 and has been running stably for nearly 2 years.

YONE 中交上航

Total Soil Test Records: 20,326 samples

Today's Soil Test Records: 9 samples

Video Surveillance Records

Passed Today: 9 vehicles

Exceeded Standard Today: 0 vehicles

Guangang Terminal Real-Time Soil Testing Data: Today's 9th Vehicle

Test Time	License Plate	Test Result	Chromium (ppm)	Nickel (ppm)	Copper (ppm)	Zinc (ppm)	Arsenic (ppm)	Cadmium (ppm)	Mercury (ppm)	Lead (ppm)	Cobalt (ppm)	Vanadium (ppm)	Antimony (ppm)	VOC Content (ppm)
2023/2/16 13:04	HuJ7616	Passed	145.25	2.95	22.33	76.38	13.79	0.02	0.31	80.68	57.42	183.52	60.76	0.32
Standard Value			Chromium≤200	Nickel≤100	Copper≤100	Zinc≤250	Arsenic≤30	Cadmium≤0.3	Mercury≤2.4	Lead≤120	Cobalt≤70	Vanadium≤752	Antimony≤180	VOC≤10
Exceeding Value			Chromium>200	Nickel>100	Copper>100	Zinc>250	Arsenic>30	Cadmium>0.3	Mercury>2.4	Lead>120	Cobalt>70	Vanadium>752	Antimony>180	VOC > 10

YONE 中交上航

Total Soil Test Records: 2,414 samples

Today's Soil Test Records: 96 samples

Video Surveillance Records

Passed Today: 96 vehicles

Exceeded Standard Today: 0 vehicles

Huijie Terminal Real-Time Soil Testing Data: Today's 96th Vehicle

Test Time	License Plate	Test Result	Soil pH	Chromium (ppm)	Nickel (ppm)	Copper (ppm)	Zinc (ppm)	Arsenic (ppm)	Cadmium (ppm)	Mercury (ppm)	Lead (ppm)	Cobalt (ppm)	Vanadium (ppm)	Antimony (ppm)	VOC Content (ppm)
2023/2/16 18:32	HuFR8181	Passed	5.6	164.35	10.84	30.68	62.13	12.5	0.25	2.19	38.75	49.96	397.25	100.48	3.25
Standard Value			PH≤14	Chromium≤200	Nickel≤100	Copper≤100	Zinc≤250	Arsenic≤30	Cadmium≤0.3	Mercury≤2.4	Lead≤120	Cobalt≤70	Vanadium≤752	Antimony≤180	VOC≤10
Exceeding Value			PH>0	Chromium>200	Nickel>100	Copper>100	Zinc>250	Arsenic>30	Cadmium>0.3	Mercury>2.4	Lead>120	Cobalt>70	Vanadium>752	Antimony>180	VOC > 10

For the Entire Lifecycle of Buildings

	Planning Stage	Design Stage	Evaluation and Review	Completion Acceptance	Operation and Maintenance Stage	Demolition Phase	Resource Utilization Phase
Recycled Products Full Lifecycle	Planning and Design Software Green Building Design Software Consideration of Construction Waste Disposal Sites, Transportation, and Application	Energy Saving Building Energy Efficiency Design Software Industrial Building Energy Efficiency Software Passive Low Energy Consumption Software Consider Construction Waste Demolition Volume and Demolition Methods	Building Energy Efficiency Review System Green Building Construction Drawing Review System Building Energy Efficiency Online Management System Green Building Online Evaluation System Waste Disposal Method Scoring Items	Energy Efficiency Evaluation Software Green Building Evaluation Software Healthy Building Evaluation Software New and Renovated Waste Disposal Records	Green Building Intelligent Operation and Maintenance System Building Sub-metering System Green and Healthy Building Management System Healthy Park Operation and Maintenance Management System Eco-city Operation and Maintenance Management System Renovation Waste Classification and Pre-treatment Monitoring Software	Automated Demolition Decision Program Construction Waste Efficient Utilization Management Platform	Recycled Product Tracking Technology

German Construction Engineering Energy-saving Product Certification

Green Building Material Evaluation and Certification

Carbon Footprint and EPD Verification

JJF

中华人民共和国国家计量技术规范

JJF ××××-××××

建筑垃圾处理过程的碳排放计量技术规范

Technical Specification for Carbon Emission Measurement in construction waste treatment process

（草案）

××××-××-××发布　　××××-××-××实施

PART 03

Performance and Cost of Recycled Products

CABR

On-site Crushing Treatment

On-site Pre-screening Treatment

The Left Side Shows Untreated Construction Waste
The Right Side Shows Treated Recycled Fine Aggregate

Coarse Aggregate

Coarse Aggregate

Fine Aggregate

Research on concrete made by recycled aggregate

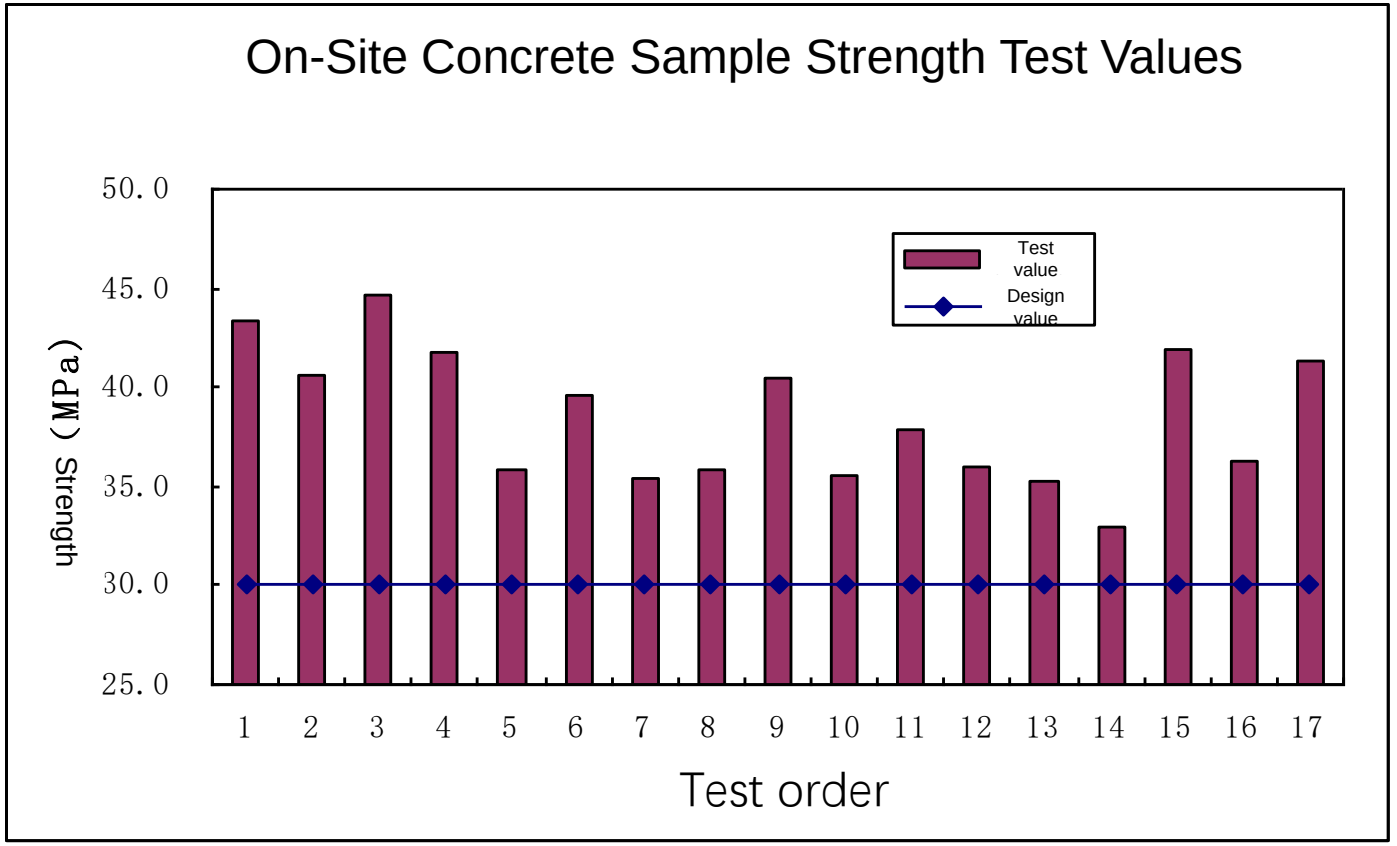
C30, 100% replacement

Maximum Value	Minimum Value	Average Value	Standard Deviation	Percentage of Design Strength Achieved (%)
(MPa)				
44.7	33.0	38.5	3.3	128

On-site Sample Strength Test: 17 sets of test blocks 28d average reached 38.5MPa, which is 128% of the design strength; the standard deviation is 3.3MPa. According to the standard (GB 50164 – 92), it is determined that the quality control has reached an excellent level.

On-site Construction Performance: The on-site working area is narrow, and the density of the steel bars is high, requiring high fluidity and good cohesion, water retention, and slump retention, using a pump truck for pumping.

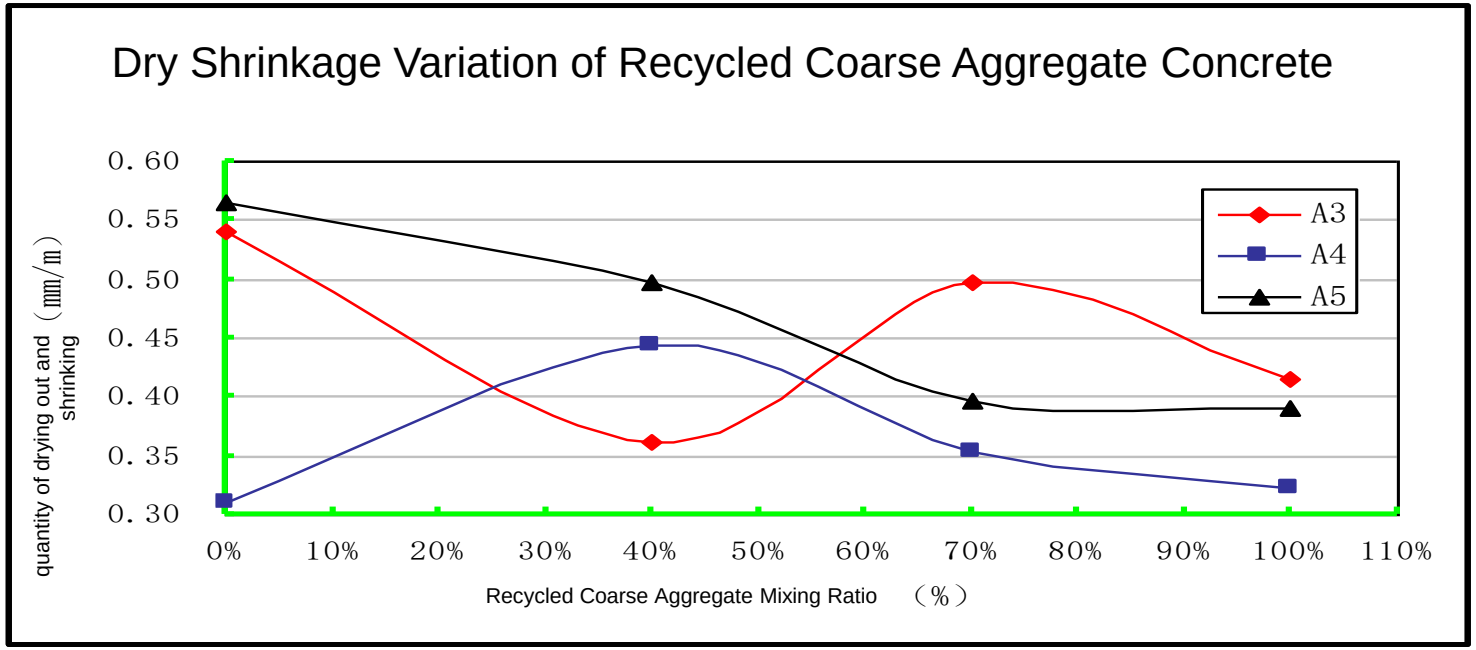
The test results show that recycled concrete meets the required workability for engineering construction.



Research on concrete made by recycled aggregate

- Dry shrinkage performance test: Recycled concrete dry shrinkage mainly occurs within the first 45 days after molding. The shrinkage amount of different aggregate recycled concrete at 45 days is basically the same as the control group with no significant variation pattern, all within the allowable range.

Group Number	1d	3d	7d	14d	28d	45d	60d	90d	180d
DL-1	0.015	0.122	0.315	0.502	0.609	0.745	0.789	0.803	0.832
DL-2	0.043	0.208	0.423	0.638	0.738	0.853	0.875	0.889	0.889



Price comparison

Mother Rock	Product Specification	Longwu Road Riverside Market Survey Price	Production Volume (10,000 tonnes/month)
-	Crushed Stone (5-16mm)	86 ↓	-
	Crushed Stone (5-25mm)	88	
	Natural Sand (2.3-2.8)	123 ↓	
	Manufactured Sand (2.8-3.3)	102 ↓	
	Recycled Aggregate (5-16mm)	60	
	Recycled Aggregate (5-25mm)	60	
	Recycled Aggregate (0-5mm)	45	
Basalt	Manufactured Sand (0-3mm, Pavement Stone)	127	
	Manufactured Sand (3-5mm, Pavement Stone)	137	
	Crushed Stone (5-10mm, Pavement Stone)	240	
	Crushed Stone (10-15mm, Pavement Stone)	240	

Sand and gravel prices in Shanghai region November

Port	Product Specification	Sand and Stone to Port Price (Excluding Tax, Yuan/ton)
Yangzhou/Zhenjiang Port	Crushed Stone (16-28mm)	67
	Crushed Stone (5-16mm)	60
	Manufactured Sand (2.3-3.5)	70
	Natural Sand (Yellow Sand 1.0-2.0)	87
	Natural Sand (Dongting Lake Sand 2.0-3.0)	85-92 ↓
	Natural Sand (Shaoyang Lake Sand 2.2-2.8)	87-98 ↓
Nanjing Port	Crushed Stone (16-28mm)	64
	Crushed Stone (5-16mm)	57
	Manufactured Sand (2.3-3.5)	71
	Natural Sand (Yellow Sand 1.0-2.0)	87
	Natural Sand (Dongting Lake Sand 2.0-3.0)	85-90 ↓
	Natural Sand (Shaoyang Lake Sand 2.2-2.8)	88-97 ↓

Some ports along the Yangtze River

According to the principle of 'who generates, pays,' the disposal fee for construction waste is about 30 yuan per tonne.

Recycled Aggregate Price 0~35 yuan/t
Cost Reduction 40% and above

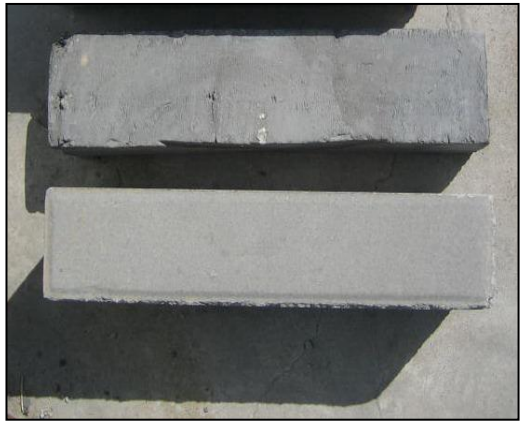
Application cases

- The Beijing Changping Tingzizhuang Sewage Treatment Plant, built with recycled concrete, has been in regular use for 13 years.
- The Beijing University of Civil Engineering and Architecture's Experimental Building No. 6, constructed with recycled aggregate concrete and recycled bricks, has been in regular teaching and experimental use for 15 years, with all functions normal and no quality issues.

- **Brick making from construction waste (product and performance comparison)**

Name	Raw Material	Energy Consumption	Pollution Emission	Flatness and Tolerance	Appearance Quality	Strength	Frost Resistance and Water Absorption	Construction	Thermal Insulation	Usage	Industrial Policy
Recycled Bricks	Construction Waste	None	Controllable Dust	Good	Excellent	Qualified	Qualified	Convenient	Moderate	Load-bearing Filler	Encouragement and Support
Sintering Clay Bricks	Clay	Burning coal	Emissions CO_2	Poor	Poor	Qualified	Qualified	Convenient	Moderate	Load-bearing Filler	Restrictions and Prohibition

- Comparison of the effect and price of recycled bricks (Beijing Area, free construction waste raw materials)



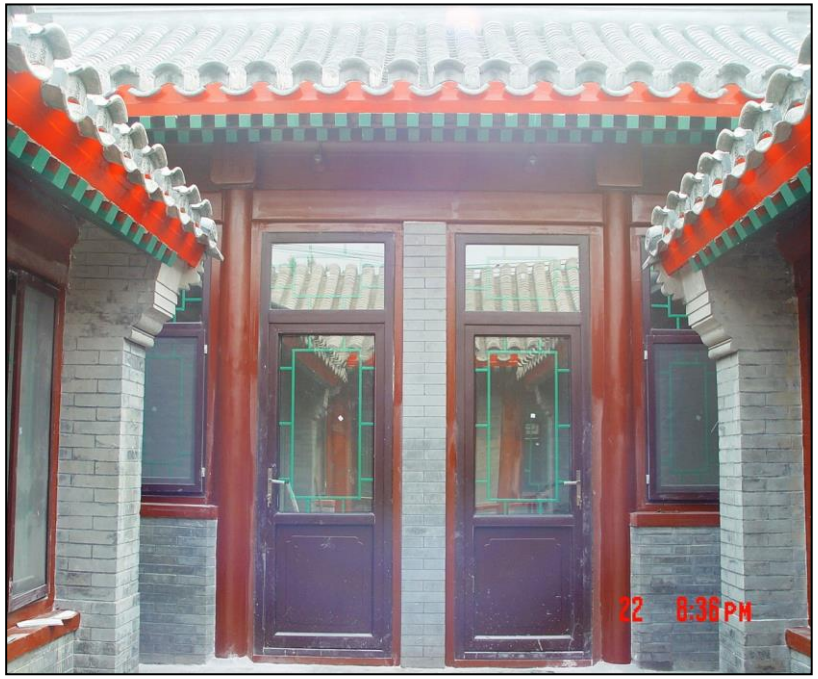
The price of recycled bricks is 0.14~0.2 Yuan/Piece. Considering the raw material cost reduction of 40%, compared to ordinary clay bricks, the cost is reduced by more than 50%.

Name	Scope of use and effect	Selling price	Year-by-year increase
Recycled common bricks	Used for ordinary buildings, good effect	0.2 Yuan / brick	-
Ordinary clay bricks	Restricted for use in ordinary buildings, good effect	0.3 Yuan / brick	0.1 Yuan / brick
Recycled ancient bricks	Used for imitation ancient buildings, good effect	0.8 Yuan / brick	-
Traditional Ancient Building Brick	Used for imitation ancient buildings, good effect	3.3 Yuan / Piece	2.5 Yuan / Piece
Imitation Ancient Clay Brick	Used for imitation ancient buildings, poor effect	1.2 Yuan / Piece	0.4 Yuan / Piece

Application cases

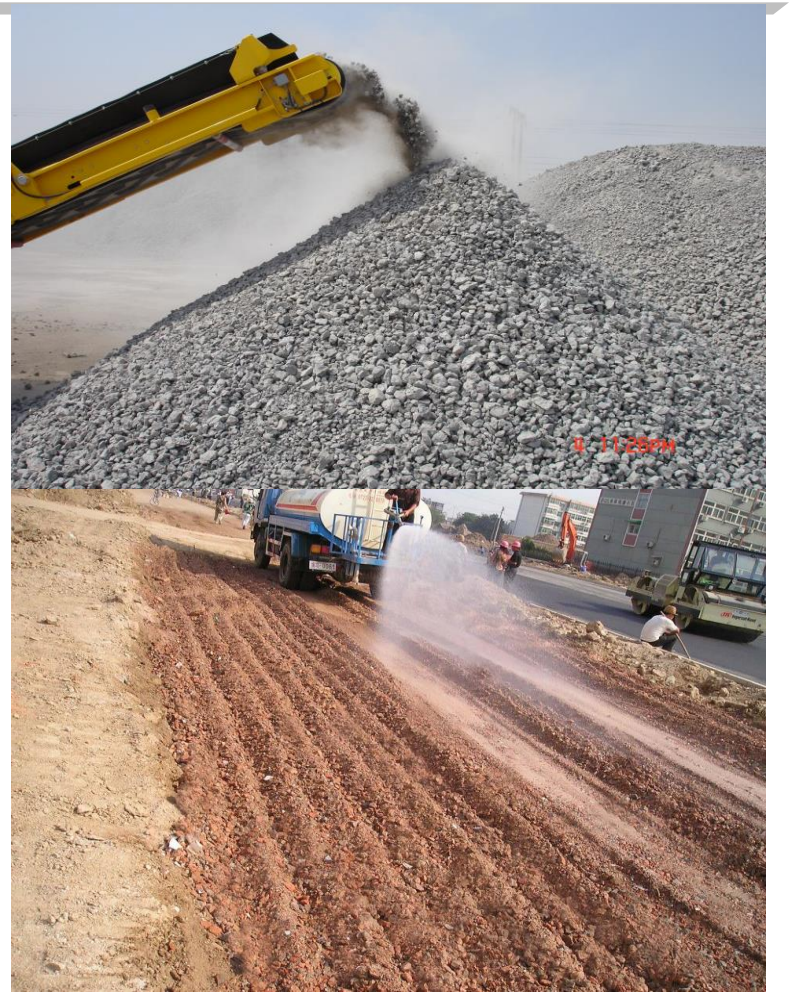
Handan Golden Century Business Center (Using Recycled Construction Waste Bricks for Filling Walls, Foundations, etc.)

Beijing Caochang Hutonneg No. 5 Courtyard 20 Imitation Ancient Building



Engineering applications exist in more than a dozen provinces and cities in China, covering an area of about tens of millions of square meters. The earliest pilot projects have been in use for 20 years without any issues, and many projects have been in use for 9 years with good results.

Performance study of recycled road materials from construction waste



Crushing Value of Recycled Aggregate

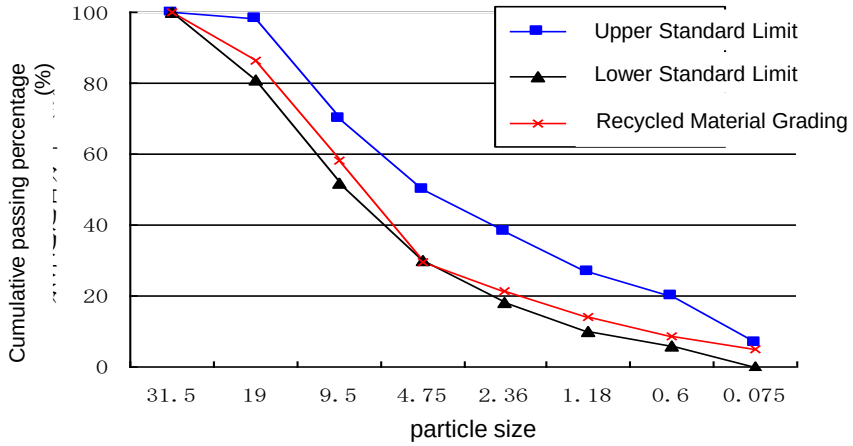
Test Content	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Crushing Value 1 (%)	33.7	31.5	27.9	28.9	33.5
Crushing Value 2 (%)	32.1	30.8	29.7	27.9	34.6
Crushing Value 3 (%)	34.3	30.3	28.4	28.4	33.3
Average Crushing Value (%)	33.4	30.9	28.7	28.4	33.8

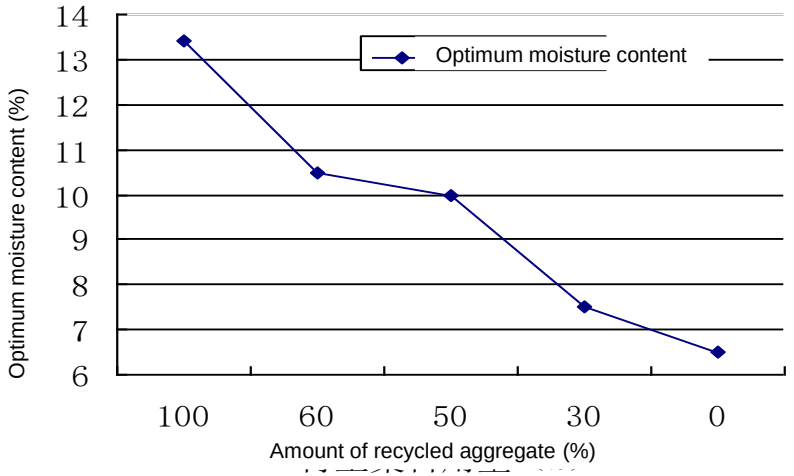
Technical Requirements for Crushing Value of Aggregates in Stabilized Soil

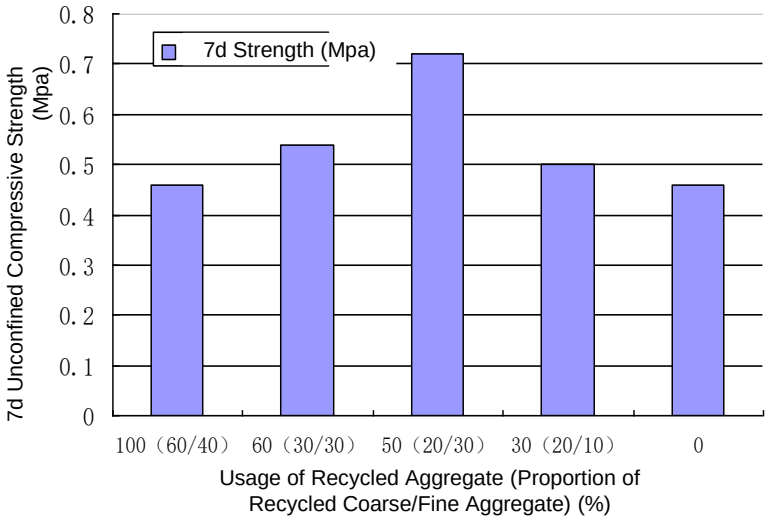
Road Grade	Secondary Road (Secondary and Below)		Main Road (Highway and Primary Road)	
Layer Position	Base Layer	Subbase Layer	Base Layer	Subbase Layer
Crushing Value Requirement	Not Greater Than 35%	Not Greater Than 40%	Not Greater Than 30%	Not Greater Than 30%

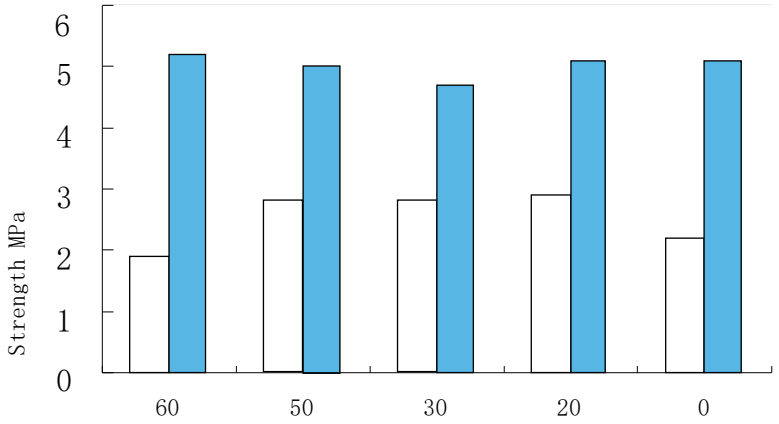
Performance study of recycled road materials from construction waste

A systematic study was conducted on the performance of recycled inorganic binders for road use from construction waste, and a test road with recycled aggregate was built, which showed good performance after use.

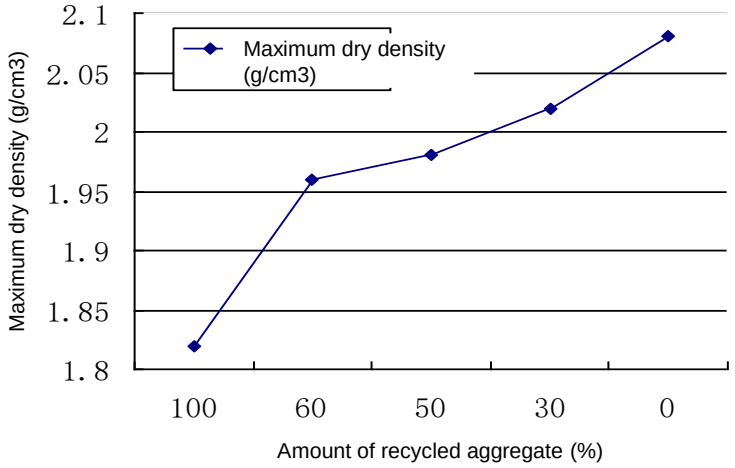








Effect of Recycled Coarse Aggregate Content on 7-day and 28-day Strength



Price comparison

Section Name	Starting and Ending Stake Numbers	Section Length (km)	Region	Construction Cost (10,000 RMB)	Required Material Quantities				
					Stone, Sand, Gravel (10,000 m^3)	Topsoil, Mountain Stones (10,000 m^3)	Medium (Coarse) Sand (10,000 m^3)	Limestone, Granite (10,000 m^3)	Basalt (10,000 m^3)
Section 5	K397+100 – K418+200	21.1	Huludao City	150,411	111	26	14	96	5
Section 6	K418+200 – K446+950	28.75	Huludao City	239,002	261	29	55	157	6.29
Section 7	K446+950 – K474+700	27.75	Jinzhou City	272,005	263	157	58	145	6.08
Section 8	K474+700 – K504+600	29.9	Jinzhou City	296,820	273	162	61	150	6.55
Section 9	K504+600 – K532+380	27.78	Panjin City	265,170	219	72	57	137	6.08

If 30% of the natural aggregate is replaced with recycled sand and gravel, the project cost can be reduced by 20%.

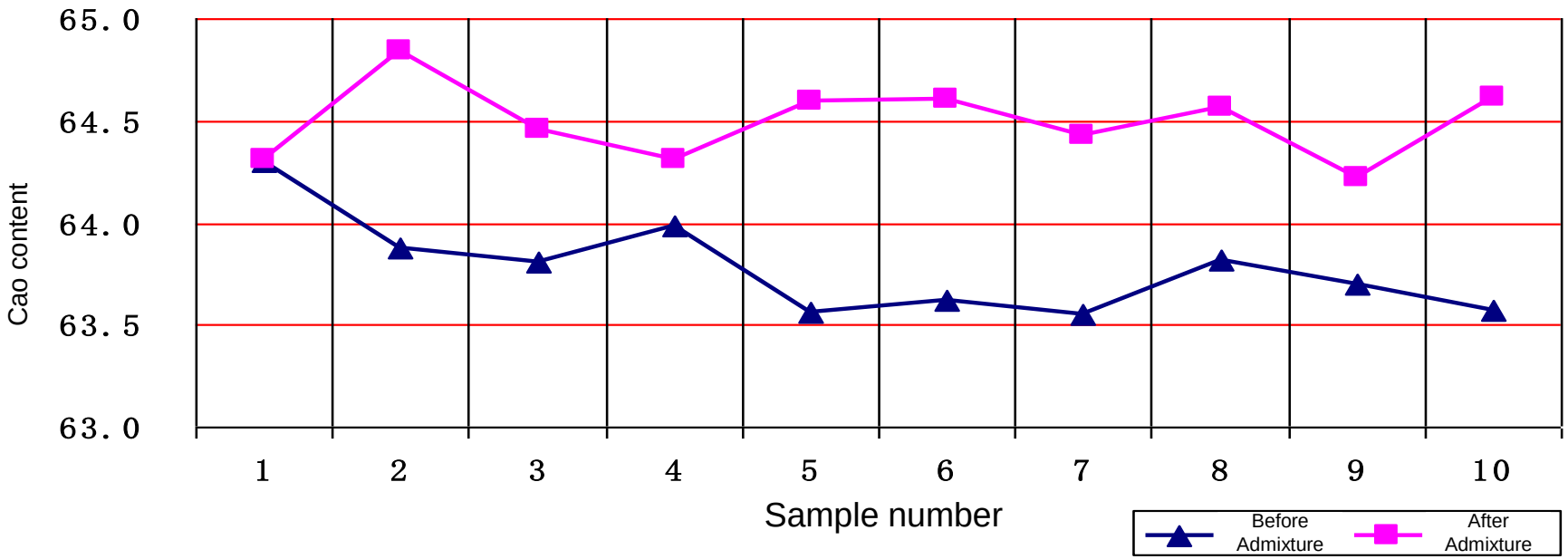
Application cases

Test Section Tracking Investigation
(Cangzhou 16 Years)

Recycled Aggregate Base Test Road
Used for 14 Years Without Any Issues

Recycled Concrete Test Road
Used for 15 Years

Construction waste recycled powder used for cement



Clinker CaO Value Before and After Adding Construction Waste (30%)

After adding construction waste, the clinker CaO content is higher and more stable. C3S is a prerequisite for the formation of CaO. A high and stable content of C3S is beneficial for the later formation of CaO, improving the strength of cement at various ages.

Construction waste recycled powder used for cement

P.C32.5 Comparison of various indicators before and after adding construction waste to cement (30%)

Item Project	Strength (MPa)				Consistency Degree	Initial Setting	Final Setting	Fineness Degree	Flow Movement Degree	Loss	MgO	SO_3	CI
	3 Days		28 Days										
	Flexural Strength	Compressive Strength	Flexural Strength	Compressive Strength									
Before Adding	4.3	17.7	9.1	38.5	29.56	199	266	2.2	227	2.6	3.01	1.85	0.0210
After Adding	4.3	17.1	8.7	40.2	29.73	204	269	2.6	222	2.7	3.01	1.84	0.0213

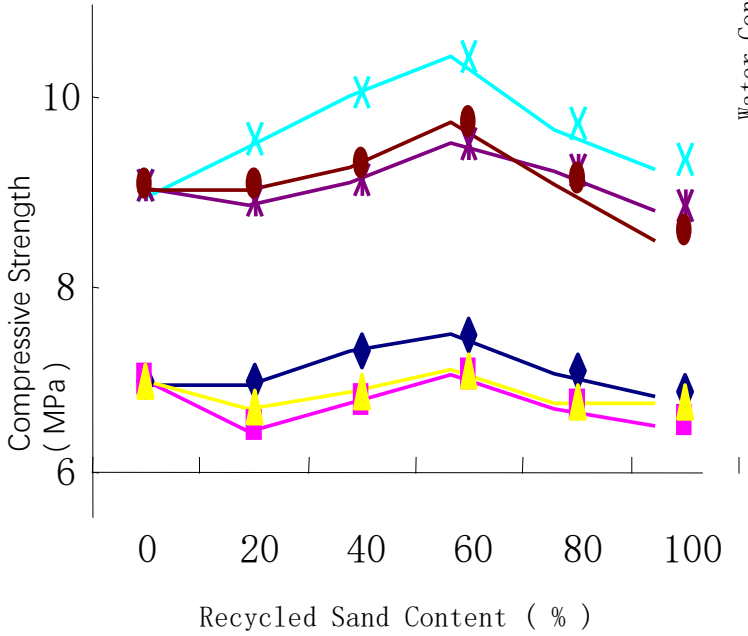
P. 042.5 Comparison of various indicators before and after adding construction waste to cement

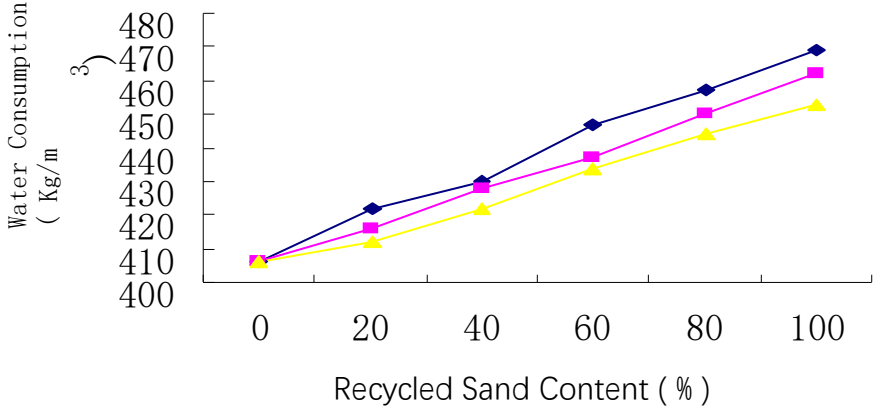
Item Project	Strength (MPa)				Consistency Degree	Initial Setting	Final Setting	Fineness Degree	Flow Movement Degree	Loss	MgO	SO_3	CI
	3 Days		28 Days										
	Flexural Strength	Compressive Strength	Flexural Strength	Compressive Strength									
Before Adding	5.4	27.2	8.3	48.5	27.56	154	206	2.2	227	2.8	3.21	2.05	0.0208
After Adding	5.6	27.9	8.5	49.4	27.73	160	209	2.6	222	2.9	3.06	2.14	0.0203

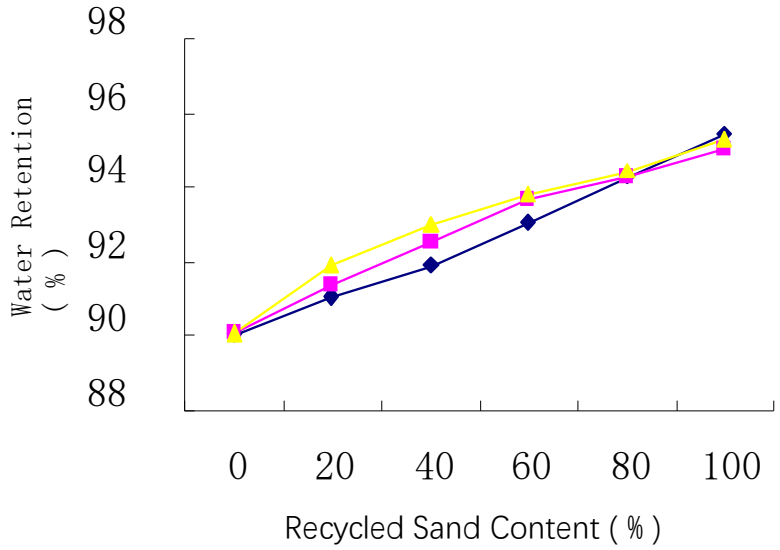
Using Recycled Powder can replace 30%, cement price can be reduced by 15 %

Performance study of recycled mortar from construction waste

The system studied the effects of different types and different amounts of recycled sand on the performance of fresh and hardened mortar. The strength of recycled mortar can reach M20 and above. A reasonable mix design can ensure the application of recycled mortar in general masonry and plastering projects.





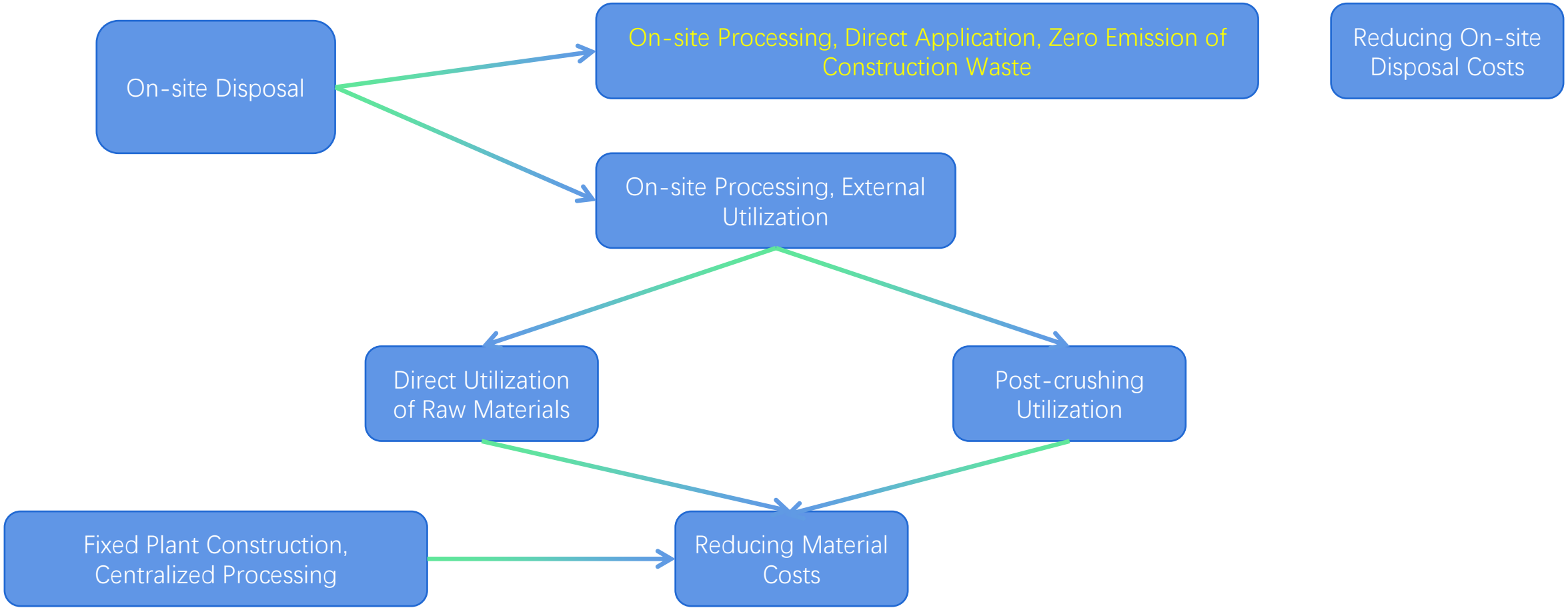


PART 04

Construction and Disposal Costs

CABR

Cost Reduction through Construction Waste Recycling



Demolition and construction waste resource disposal cost

Based on the resource cost of fixed and mobile construction waste projects in Shaanxi Province, Yunnan Province, Beijing, Shanghai, Shenzhen, and other regions.

Cost Items		Fixed Projects	Mobile Projects
Fixed Costs	Construction Project Costs	45.2 million yuan, including: 28 million yuan for construction costs, 6.4 million yuan for other construction costs, and 10.8 million yuan for basic contingency costs	0
	Land Costs	25.2 million yuan	0
	Equipment Cost	55.3 million yuan, including: equipment purchase cost of 51 million yuan, equipment installation cost of 4.3 million yuan	13.4 million yuan
	Material Procurement Cost	**12 million yuan (transportation cost calculated at 7 yuan/t, sorting cost calculated at 1 yuan/t)**	**1 million yuan (sorting cost calculated at 1 yuan/t)**
Operating Cost	Labor Cost	18.3216 million yuan	8.24 million yuan
	Fuel and Power Cost	12 million yuan	1 million yuan
	Annual Depreciation and Maintenance Cost of Assets and Equipment	3.5 million yuan	336,000 yuan
	Others	20 million yuan	550,000 yuan
Total	Subtotal of Total Cost (Static)	863.024 million yuan	172.59 million yuan
	Subtotal of Total Cost (Dynamic, calculated at I=8%)	1,429.158 million yuan	301.1109 million yuan
	Cost per tonne (Static)	28.77 yuan/tonne	11.51 yuan/tonne
	Cost per tonne (Dynamic, calculated at I=8%)	47.64 yuan/tonne	20.07 yuan/tonne

Taking the demolition waste cost of a project in Beijing as an example

工程名称[redacted]
区装修

第 1 页 共 1 页

序号	单位工程名称	金额（元）	其中：		
			暂估价（元）	弃土或渣土运输和消纳费（元）	规费（元）
1	分部分项工程	4820286.22			260496.75
1.1	拆除工程	201369.25			35376.92
1.2	土建结构工程	141369.1			3671.22
1.3	装饰装修工程	2003160.93			84471.91
1.4	电气工程	915883.75			43107.64
1.5	弱电工程	319193.45			18347.82
1.6	消防工程	354774.91			33659.94
1.7	通风工程	884534.83			41861.3

工程名称：拆除工程

第 1 页 共 1 页

序号	子目编码	子目名称	子目特征描述	计量单位	工程量	金额（元）			
						综合单价	合价	其中	
								暂估价	规费
		整个项目					7717.5		
1	01B001	装饰范围内的拆除工程及垃圾外运	1.工作内容:拆除顶面、墙面、地面原有装饰面及原大楼装饰面 2.要求:所有项目拆除至装修图纸及清单要求的工作面；拆除垃圾清理及外运、及拆除墙体凿毛冲洗、墙面涂刷界面剂自行考虑在报价内 3.范围:设计图纸装饰范围内的拆除项目（设计图纸地面装修面积）	项	1	77107.5	77107.5		
		分部小计					77107.5		
		措施项目							

The total amount of sub-projects for a renovation project in Beijing 4.82 million yuan, generating construction waste, demolition and transportation of waste 770,000 yuan.

On-site sorting and disposal of demolition waste, construction waste demolition and transportation costs reduced by 30% or more.

Renovation waste resource disposal cost

	Project Name	Quantity	Unit Price	Total Cost (10,000 yuan)	Unit Cost (yuan/t)
Operating Cost	Wages and Benefits	43 people	120,000 yuan/person	516	34.40
	Fuel Cost	150000L	7.1 yuan/L	106.5	7.10
	Tap Water Fee	3280t	4.4 yuan/t	1.44	0.10
	Electricity Fee	2736000kWh	1.13 yuan/kWh	309.17	20.61
	Maintenance Fee	3%		112.99	7.53
	Monitoring Fee			50	3.33
	Landfill Fee	15000t	38.25 yuan/t	57.38	3.83
	Other Fees			57.67	3.84
Depreciation Fee				423.28	28.22
Amortization Fee				4.67	0.31
Financial Expenses	Construction Investment Loan Interest			39.71	2.65
	Working Capital Loan Interest			10.66	0.71
Total				1689.47	112.63

Renovation waste resource transportation cost

Project Name		Cost Unit Price	Quantity	Total (yuan/year)
Management Personnel Fees (including property)	Salary and Social Security	106720 yuan/person/year	2 people	213440
	Insurance	750 yuan/person/year	2 people	1500
Driver Costs	Salary and Social Security	87,000 CNY/person/year	15 people	1305000
	Insurance	750 yuan/person/year	15 people	11250
On-site Auxiliary Personnel	Salary and Social Security	47,700 CNY/person/year	2 people	95400
Vehicle Costs	Vehicle Insurance	8,600 CNY/vehicle/year	15 vehicles	129000
	Vehicle Maintenance + Repair	30,000 CNY/vehicle/year	15 vehicles	450000
	Fuel Costs	1.91 CNY/km	720,900 km/year	1376919
	Loader Costs	80 CNY/instance	12,015 instances/year	961200
	Information Management Equipment Data Fees	400 yuan/vehicle/year	15 vehicles	6000
	Vehicle depreciation cost	24595 yuan/vehicle/year	15 vehicles	368925
Total annual transportation cost				4918634
Taxes, corporate management fees, corporate profit				737795
Total				5656429

Single-trip transportation costs **3.76 yuan/t/km, disposal costs 112.63 yuan/t.**

2.5-tonne truck (van/flatbed), dimensions: length 4.2 meters × width 1.9 meters × height 1.8 meters, actual load capacity: 3 tonnenes/12 cubic meters

Beijing one trip 1000~1200 yuan varies.

Engineering spoil landfill cost

Cost Items		Cost amount
Fixed Costs	Factory cost	3 million yuan
	Infrastructure construction within the factory area	1.2 million yuan
	Land cost	0 yuan
	Equipment Cost	20 million yuan
	Material Procurement Cost	12 million yuan
Operating Cost	Labor Cost	3.71 million yuan
	Energy Cost	0.5 million yuan
	Annual Depreciation and Maintenance Cost of Assets and Equipment	1 million yuan
	Other Costs	1.8 million yuan
Total	Subtotal of Total Cost (Static)	2,841.5 million yuan
	Subtotal of Total Cost (Dynamic, calculated at I=8%)	4,922.879 million yuan
	Cost per tonne (Static)	9.47 yuan/t
	Cost per tonne (Dynamic, calculated at I=8%)	16.41 yuan/t

National Standard for Soil Removal Fee: One standard truck 500. Generally 15 tonnes load

25 yuan per kilometre on average, the farther the distance, the higher the cost.

高流态混凝土非承重墙体与传统加气块混凝土砌块砌筑墙体经济效益对比分析计算								
项目名称	材料费（元/立方米）		工程量	人工费（元元/平方米）	材料费合价	人工费	合计	合价
加气混凝土砌块砌筑墙体（双面抹灰）	砌块	335	972.16	43	325673.6	209014.4	551284.45	866538.2
	M5.0砌筑砂浆	425.55	39		16596.45			
	M7.5抹灰砂浆	519.89	195	22	101378.55	213875.20	315253.75	
高流态混凝土墙体（免抹灰）	工程量			高流态混凝土综合单价（元/立方米）（人工+材料）				合价
	972.16			600.21				583500.15
经济效益（元）	866538.2-583500.15=283038.05							

Shenzhen Konka Guangming Technology Center (Phase I) Project

The Konka Guangming Technology Center (Phase I) project is the first in the country to attempt using high-fluidity concrete made from recycled construction waste for non-load-bearing wall casting. “CCTV1” tracked the successful application of this technology, causing a strong reaction in society and receiving high praise from all sectors.

Cost reduction per square meter 291 yuan.

- Benefits of Recycling Construction Waste (based on the current 100 million tonnes of construction waste)

Project	Material Saving	Land Saving	Coal Saving	Environmental Protection	Increased Production and Cost Savings	Newly Added Taxes and Profits
Recycled Brick Production	Production of Standard Bricks 24.3 billion pieces Mixed Material 36 million tonnes	Land saved for brick firing 15 thousand acres, Reduced land occupation 22.5 thousand acres	270 million tonnes	Protect the environment and reduce emissions by 1.3 million tonnes CO_2	11 billion	2.7 billion
Recycled Concrete	Produce recycled aggregate 10 million tonnes	Save natural aggregate 10 million tonnes Reduce land occupation by 2500 mu	-	Protect the environment	550 million	100 million
Stacking	-	Occupy 25 thousand mu of land	-	Environmental Pollution	-	-

If an industry can be formed, it will generate a comprehensive economic benefit of about 450 billion yuan per year, with significant social and environmental benefits. The resource utilization and industrialization of construction waste are imperative.

Taking the complete resource utilization of 1 billion tonnes of construction waste as an example, it will reduce the mining and transportation of 1 billion tonnes of natural sand and gravel, bringing the following social benefits (calculated based on the average transportation distance of natural sand and gravel in China being 100 kilometres):

1. The value of replacing natural sand and gravel is 1 billion tonnes× 200 yuan = 200 billion yuan.
2. Reduced transportation costs of 100 billion yuan, calculated at 1 yuan/t-km.
3. Reduced fuel consumption by 3 billion liters, calculated at 0.03L/t-km.
4. Avoided rehabilitation of two-lane secondary highways for 2000 kilometres, reducing highway investment by 10 billion yuan (calculated based on 3-axle trucks, 15 tonnes per truck, 1 billion tonnes requiring 40.02 million axle trips = 6.67 million trucks × 3 axles × 2 trips, with the design service life of secondary roads in China being 10 years, and the cumulative standard axle passes per single lane per year being 1 million times).
5. Every year, transporting 1 billion tonnes of natural sand and gravel requires 130,000 vehicles, reducing vehicle investment by 40 billion yuan (the national road traffic accident fatality rate is 3.2 per 10,000 vehicles) and significant non-fatal accident losses.
6. Reduce carbon dioxide emissions from transport vehicles by 4.5 billion tonnes.
7. Reduce the use of 168 million kilograms of explosives for earth and rock excavation, reducing the carbon dioxide produced by blasting by 13.4 billion litres (the general explosive consumption for the earth and rock blasting is 0.3 kg per cubic meter, producing 80 litres of carbon dioxide per kilogram).
8. Extracting 1 billion tonnes of natural sand and gravel will destroy 20 million square meters of natural vegetation, and the dust pollution generated during extraction and transportation will be immeasurable. Therefore, the damage to the natural environment and the pollution caused to the environment cannot be measured in economic value.

Reconmatic

Funded by the European Union

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