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Post-disaster resettlement model designed by the BJTU+ team

Exploring new post-disaster relief plans

in line with the International system

Project Partners |



breTRUST

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Editor's note: Millions of people were forced to leave their homes due to the increasing climatic hazards that have happened over the past 20 years. In order to improve the quality of post-disaster relief, the team BJTU+, who is one of the participants in the 2021 Solar Decathlon China (SDC) competition, went to Zi Zhong County in Sichuan Province, a county that has been heavily affected by the flood, to further explore the post-disaster relief plans in line with the international system.

Exploring new post-disaster relief plans in line with the International system

On August 17, 2020, affected by continuous heavy rainfall at the upper reaches, the Tuojiang River Basin in China saw the biggest flood peak since 1981, flooded several towns in Zi Zhong County.

When the flood peak passed and the situation was relatively stable, the BJTU+ team departed to Zi Zhong County, which was severely affected, to investigate the post-disaster resettlement situation. We found that safety, hygiene and independence were the main expectations of most interviewees for their post-disaster resettlement environment, whether it's dispersed resettlement, going and staying with relatives and friends, or using existing buildings such as schools for resettlement. This reflects people's urgent needs for security and shows the fact that in order to create a well-balanced living condition we need to take its sustainability into consideration, as well as people's physical and mental health.



Learn from different evaluation systems to create a more sustainable post-disaster living environment

Currently, there are evaluation systems at home and abroad that are used to measure the sustainability of post-disaster resettlement buildings. For example, the Technical Guidelines for the Construction of Temporary Resettlement Houses in Earthquake-stricken Areas and the Guidance Manual for the Reconstruction of Homes in the aftermath of Earthquakes issued by the Chinese government, provide guidance for the construction of temporary resettlement buildings from the perspective of planning, structural design etc.

The [QSAND](#) (Quantifying Sustainability in the Aftermath of Natural Disasters) tool, developed by the BRE Trust, is also a comprehensive built environment tool that provides guidance for sustainability assessments.

The system includes an assessment mechanism for the sustainability of post-disaster buildings, including shelter and community, energy, materials, waste and others, in total eight categories.

Shelter & Community	Settlement	Material & Waste
<ul style="list-style-type: none"> – Privacy – Internal Environment – Community Sensitive Design – Construction Approaches 	<ul style="list-style-type: none"> – Site Selection – Security of Tenure – Spatial Planning – Infrastructure 	<ul style="list-style-type: none"> – Post Disaster Waste Management – Construction Waste Management – Operational Waste Management – Material Properties / Specification – Material Sourcing
Energy	Water & Sanitation	Natural Environment
<ul style="list-style-type: none"> – Energy Demand and Supply – Energy Consumption 	<ul style="list-style-type: none"> – Water Demand and Supply – Water Quality – Sanitation 	<ul style="list-style-type: none"> – Human Relationship to Ecosystem Services – Ecological Protection – Ecological Rehabilitation and Restoration
Communications	Cross-Cutting Issues	
<ul style="list-style-type: none"> – Telecommunication 	<ul style="list-style-type: none"> – Participation – Skills and Capabilities – Security and Safety – Economic Viability 	<ul style="list-style-type: none"> – Community Ownership and Sustainable Management – Livelihoods – Resilience – Access and Non-discrimination

It is a convenient tool for different countries and regions to self-adapt and to refer to for their own sustainable post-disaster building construction.

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6	

- 1-4. The BJTU+ team is conducting a questionnaire to the affected residents
5. "Word cloud" of interviewees' expectations of the post-disaster resettlement environment
6. QSAND assessment and cross-cutting issues by category. Source: qsand.org

A new way of thinking on the post-disaster rescue plan in line with the QSAND system

In order to improve the comfort of the buildings, optimize the way disaster relief has been constructed, as well as to improve the energy and medical supplies, our team put forward a design scheme called BBBC - a strategy that includes multifunctional relief bag (Bag), modular relief Box (Box) and a combination of disaster relief spaces (Building). These three are managed by the Disaster Preparedness Cloud (Cloud) and can be utilized with flexibility according to the needs of different

stages of disaster relief. (For more details, please visit the [team's website](#))

The program runs through the whole process of disaster preparation, disaster relief, resettlement and recovery, with an aim to help rescue teams cope with the challenges at different stages. In line with the QSAND international system for sustainable post-disaster buildings, we would like to share the following eight new features:



① Shelter and Community

The lightweight design creates a modular space that can be expanded flexibly

In order to make the rescue more smooth and efficient, the whole building is constructed of 6063-T5 aluminum, which not only ensures the quality of the construction, but also reduces the weight of the building by 70% compared to steel structures.

We developed a folding design from the inside out for each module. This special design includes using film or modular panel walls as exterior walls; applying a self-developed mechanical device on the modules to realize the entire panel;

as well as adopting a folding furniture design at household scale to increase the utilization rate. In the end, all this can increase the module space compression ratio by 500%.

② Comfortable Living Space

Adopt environmental system based on climate regulation and a flexible space combination

In terms of the internal environment, we plan to use a full set of smart sensors and smart home systems to achieve dynamic control of temperature and humidity. The flexible partition wall combination can also meet different needs.

③ Materials and Waste

Using recyclable materials effectively to construct environmentally friendly buildings

More than 80% of the architectural design is made of recycled materials, such as aluminum panels as the main material for the veneer, recycled materials for the furniture, and waste materials as the main filler in some parts of the landscape.

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2	3	4

1. BBBC design video (Click picture to view)
- 2-4. In order to create a comfortable living space, the project adopts smart home systems and flexible partition wall combination. The picture shows the interior space of the model.



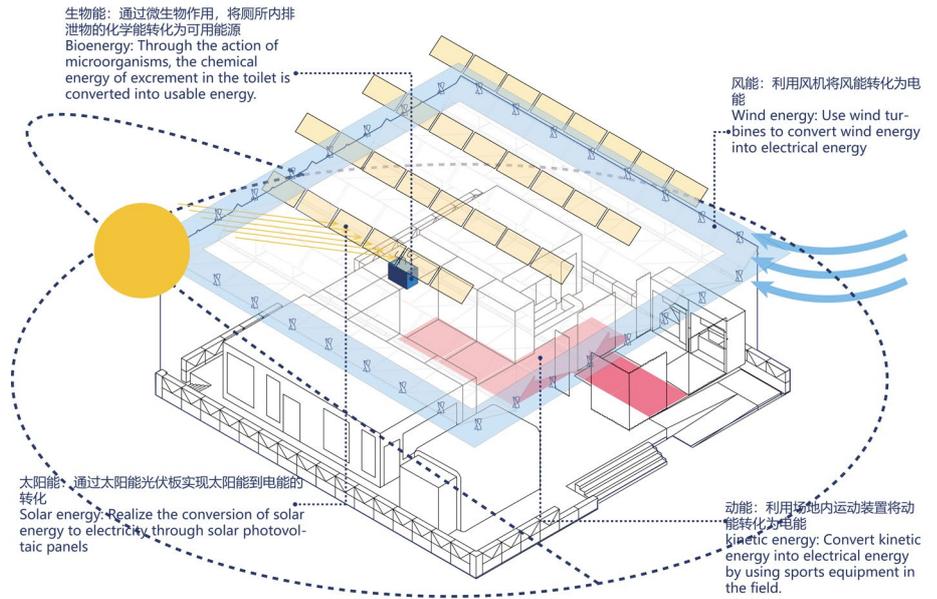
Exploring new post-disaster relief plans in line with the International system

④ Energy

Flexible energy supply to reduce energy consumption

Regarding the form of energy supply and considering the uncertainty of different scenarios, the project uses photovoltaic as the main energy source and adopts the complementary elastic energy supply mode that combines water potential energy + fossil energy + biological energy + wind energy.

The building uses DC power from the power supply to the electrical appliances to realize the full utilization of DC power in the whole building. The full DC building design cannot only reduce energy consumption by 10%, but also control the voltage within a safe range that can be passed through the human body at the electrical terminal, such as a socket, so as to control the risk of the use of electricity.



⑤ Water and Sanitation

Building a water recycling system to ensure the safe use of water

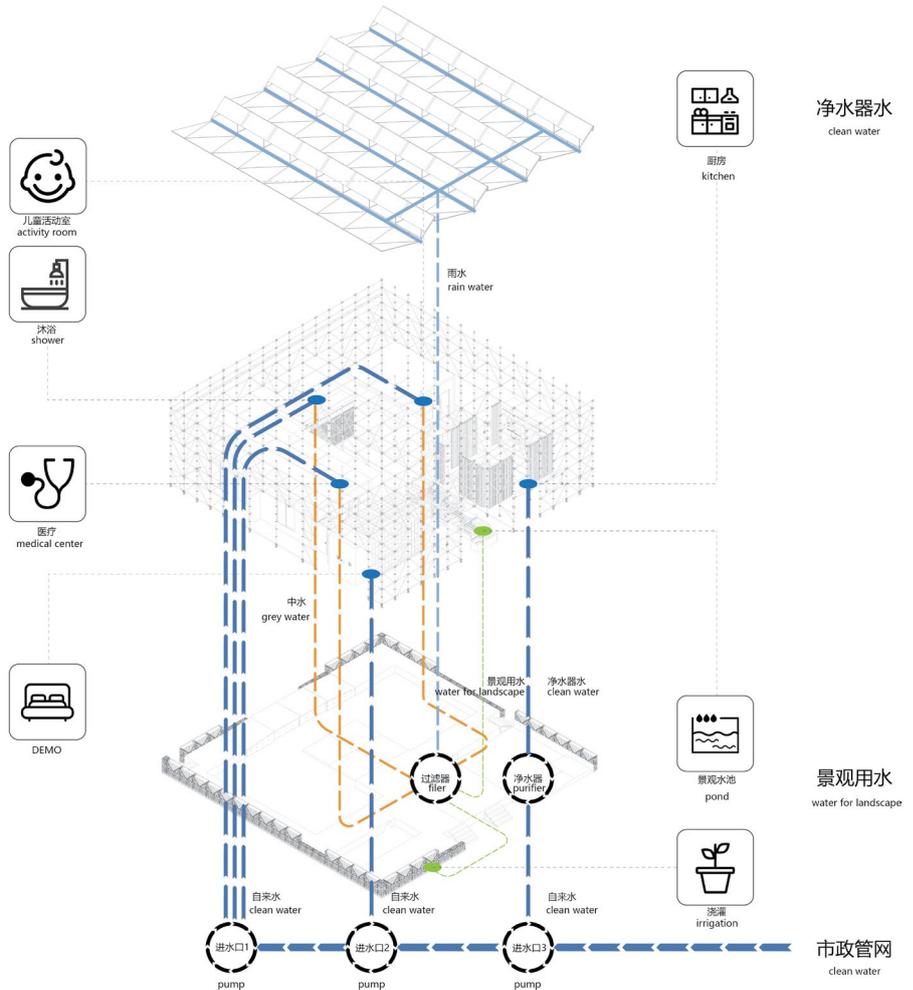
We classified and screened different kinds of water and established water quality standards. We have also designed a water circulation system to ensure the safety of water for users.

⑥ Humanitarian Care

A shelter design that can be quickly disassembled, showing humanitarian care to special groups of people

For the landscape, we designed temporary shelters that can be quickly disassembled according to the needs for post-disaster social recovery, which can not only expand the usable area, but also provide a sense of protection for the affected people.

The team designed an accessible infrastructure for the landscape, architecture and furniture. Nursing rooms, infirmary and children's activity rooms have been installed for the needs of special groups of people.

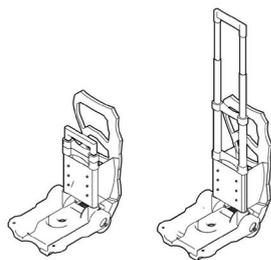


1. The project takes photovoltaic as the main energy source and adopts the complementary elastic energy supply mode that combines water potential energy + fossil energy + biological energy + wind energy.
2. The project creates a water circulation system to ensure the safety of the water

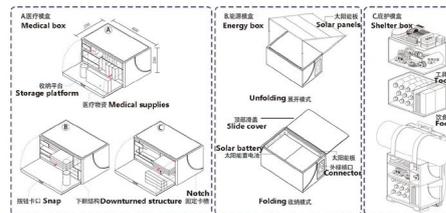
⑦ Smart Rescue and Management

- Provide telemedicine plan
- Design a rescue strategy from the equipment to the community for each stage of rescue

The program also shows characteristics of telemedicine and smart physical examination. Through internet communication and data analysis, the patient's medical condition and nursing plans were analyzed and decided efficiently.



主体背负系统 (可背可拉)
Main carrying system (can be carried and dragged)



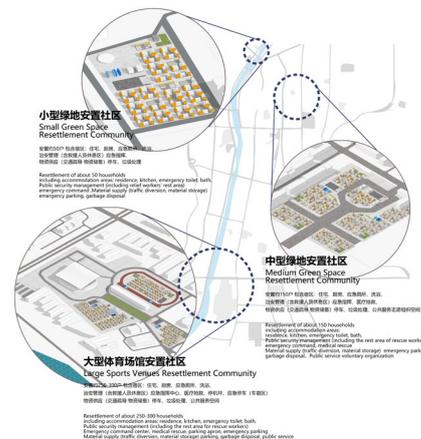
配套储存系统 (模块化集成化)
Supporting storage system (modular and integrated)

⑧ Cross-cutting Issues

Design reusable modules and focus on the sustainability of each design

The module can be reused more than 30 times to reduce the waste of resources.

In the landscape space, economic crops are selected for the purpose of landscape planning. Rain water filtered by the self-made water purification device in the atrium can be used directly for irrigation. The waterless toilet can continue to decompose and process the waste into fertilizer, and then been transported to the landscape for compost, so as to realize the sustainable development of resources. In this way, the villagers can rebuild their spiritual relief through the post-disaster agricultural livelihood.



For the emergency relief stage, we designed multifunctional lightweight backpacks with a streamlined design which fits the human body, providing a good user experience and allowing relief teams to carry relief supplies to the disaster affected areas more easily. The module integrated supporting storage system covers food, medicine, rescue tents and other first-aid supplies, which can be used immediately on arrival.

For the transitional resettlement stage, according to the common disaster resettlement needs, we designed three kinds of resettlement communities, namely a small green space resettlement community, a medium school resettlement community, and a large sports venues resettlement community, so as to better manage the community and make people's lives easier.

Disasters happen and exploration continues

According to the UN report "Human Cost of Disasters 2000-2019", over the past 20 years, the number of global flood disasters has tripled from 1,389 to 3,254, accounting for 40% of the total disasters, which affected 1.65 million people. This was followed by storms, which accounted for 28 percent of the total, up from 1,457 to 2,034. In addition, droughts, wildfires, extreme temperatures, and natural disasters such as earthquakes and tsunamis have all seen significant increases.

Sustainable development focuses on long-term, scientific planning. Most importantly, the support to areas affected by the disasters should be sustainable as well. Only by seeking better post-disaster relief programs can the displaced people quickly find a warm and comfortable home after the disaster.

Our exploration continues...



Unless otherwise stated, all images are provided by BJTU+ team.
Zhao Ruyue and Bao Yaru also contributed to this article
Translated by Shuang Hibberd from the original version 《结合国际体系，探索灾后救援新方案》
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Together we bring hopes,
enrich lives and build for the future

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