

# About Okinawa's Distinctive Construction Technologies



Okinawa is located almost in the center of mainland Japan and Southeast Asia. The mild subtropical climate, rich natural environment, and islands of various sizes make Okinawa a different environment from that of mainland Japan, thus construction industries such as social infrastructure and private construction have developed and distinctive construction technologies have been cultivated.

① Red clay flow-out prevention measures, environment conservation



② Salt damage measures, extending infrastructure service life



③ Water supply, water purification



④ Disaster prevention measures



⑤ Houses for hot and humid areas



⑥ ICT utilization

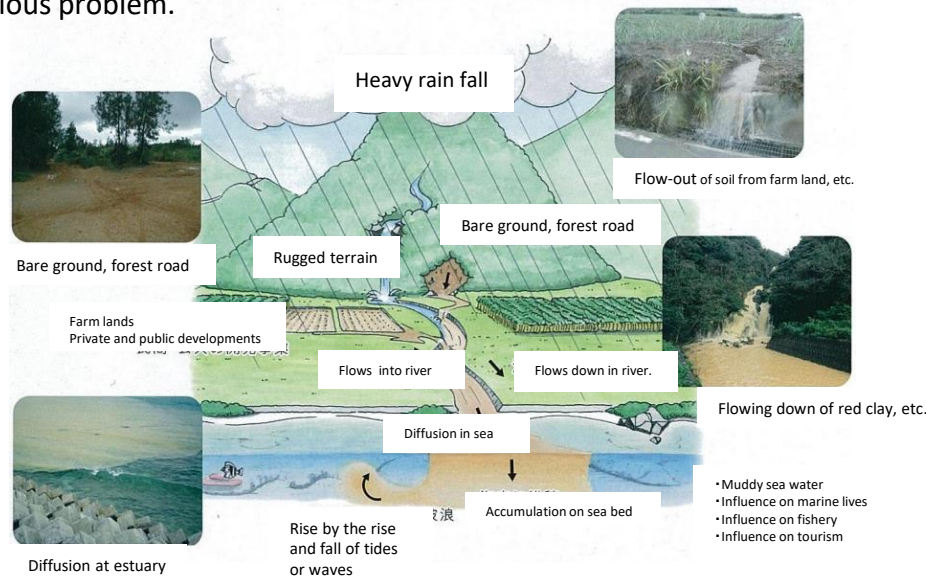




# ① Red clay flow-out measures, environment conservation

## Regional characteristics of Okinawa

• Red clay refers to red soil that accounts for about 70% of the soil in Okinawa Prefecture, and this red clay flows out through the river to the surrounding seas, thereby adversely affecting the natural environment such as coral reefs, the fishery industry and the tourism industry in Okinawa. It is a serious problem.



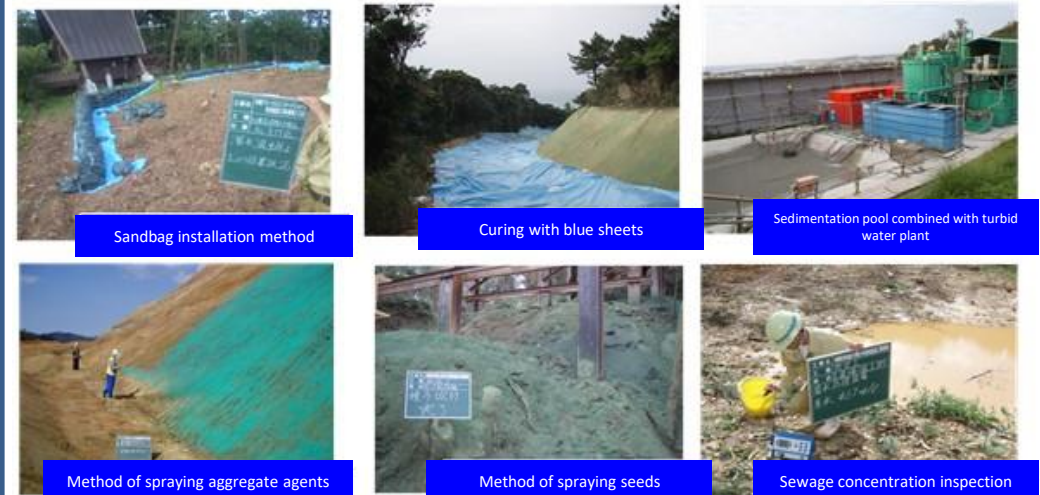
## Current situation abroad

• In island countries such as Oceania, along with the development of their lands, the occurrence of turbid water including domestic wastewater spreads to the rivers and beach areas, leading to deterioration of the environment.



## Knowledge of Okinawa

• For the red clay issue, Okinawa Prefecture enforced the "Okinawa prefecture red clay flow-out prevention ordinance" in 1995; and we are implementing measures based on "Technical guidelines for preventing red clay flow-out (draft)", which summarizes basic ideas and plans for the measures, design and construction of facilities and their maintenance for the measures. The know-how is being accumulated in relevant companies in Okinawa.



• In addition, companies in Okinawa have highly practical technologies such as a system that can purify water by filtering pursuant to the amount and properties of water and by reducing contained heavy metals etc.



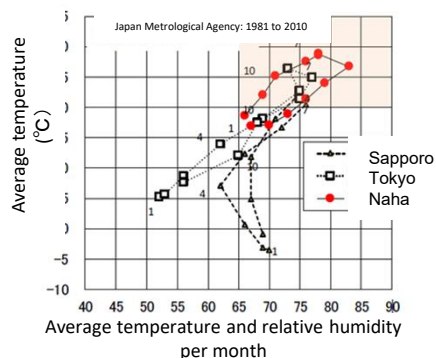
International Cooperation of  
Companies in Okinawa  
(Technical support, human resource  
development, etc.)

- JICA small and medium-sized enterprise overseas business development support project (project investigation) (country: Samoa, sponsor: JICA, construction consultant in Okinawa)
- JICA small and medium-sized enterprise overseas business development support project (project investigation) (country name: Fiji, sponsor: JICA, manufactures in Okinawa)

# ② Salt damage measures, extending infrastructure service life

## Regional characteristics of Okinawa

- Okinawa has a subtropical maritime climate: a high temperature and humidity throughout the year. Furthermore, due to the island environment surrounded by the seas, typhoons and winter winds bring a large amount of flying salinity in the environment.
- This represents that the structures in Okinawa are under more harsh environment compared with other areas in Japan and the deterioration rate of the structures in Okinawa very fast.



Corrosion condition of sea bridge

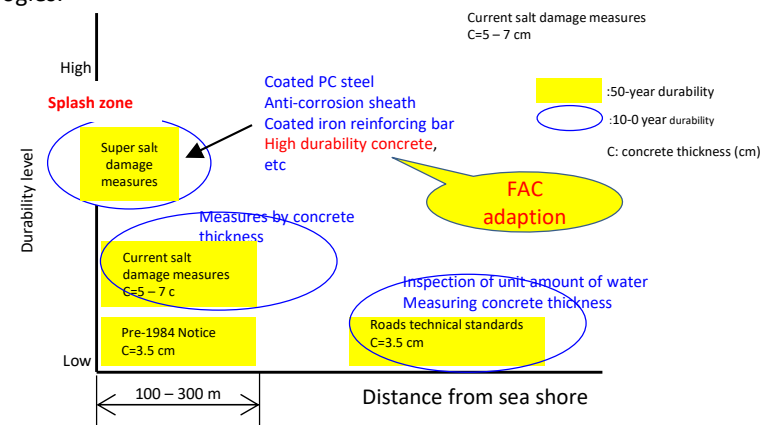
## Current situation abroad

- In coastal areas of Southeast Asia and island regions including Oceania's, they have hot and humid environment, which is harder than that in Okinawa; their structures are under harsh natural environment. Therefore, measures against salt damage at the time of construction, maintenance/management and repair technologies for existing infrastructure facilities considering the weather conditions and regional characteristics are required.



## Knowledge of Okinawa

- In the harsh natural environment for structures, Okinawa companies have accumulated know-how on salt damage measures, including high-durability concrete, and maintenance and repair technologies.



## Introduction of High quality Fly Ash Products (CfFA=Carbon-free Fly Ash)

CfFA I	CfFA II	CfFA IV
		
Average diameter: 2 to 3 microns Specific surface area: 7,000 to 10,000cm <sup>2</sup> /g	Average diameter: 10 to 20 microns Specific surface area: 3,500 to 5,000cm <sup>2</sup> /g	Average diameter: 30 to 60 microns 30 Specific surface area: 2,000 to 3,000cm <sup>2</sup> /g
		
High-strength concrete Concrete repairing materials, etc.	Materials to be mixed with concrete (Sold by Okinawa ready-mixed concrete union)	Ryukyu plaster products

In addition to standard ready-mixed concrete, the products are used in high-strength concrete (type I) for large-scale structures such as high-rise buildings, condominiums and in other traditional Ryukyu plaster products (type II) in Okinawa, contributing to enhancing added value.

International Cooperation of Companies in Okinawa  
(Technical support, human resource development, etc.)

- JICA Grant Aid Preparation Member (Country: Samoa, Sponsor: JICA, construction consultant in Okinawa)



# ③ Water supply, water purification

## Regional characteristics of Okinawa

In the small communities in Okinawa, raw water was used to be taken from the upstream of rivers running through the communities and supplied to each household after being slowly filtered. Small rivers became turbid when heavy rain fell, problems such as clogging of sand filter ponds and supply of muddy water were occurring.



Water supply source for a small community



Water supply source (when rained)

## Current overseas situation

- In island countries such as Oceania, there are many areas with poor water resources due to topographical and climatic conditions. In order to improve living standards there, it should be necessary to secure safe water resources.
- In order to make efficient use of poor water resources and to improve the soundness of water management, measures to no-water intake and water leak are required.

## Knowledge of Okinawa

- In Okinawa, there are communities' water supplies which took water from subterranean river so as to secure constant water quality even at the time of rain fall. In this way, know-how on technology for taking water from subterranean river and the relating design methods have been accumulated in Okinawa.
- Based on this knowledge of Okinawa, a company has worked on a JICA dissemination/ demonstration project by constructing a pilot plant. As a result of measuring the turbidity of raw water and underground water intake, the effect of turbidity removal rate of 80 to 90% during rainfall was confirmed.

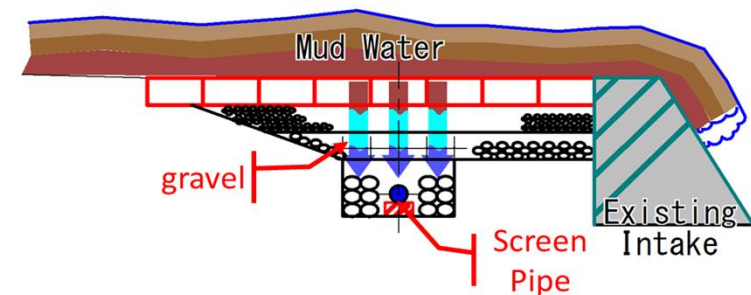
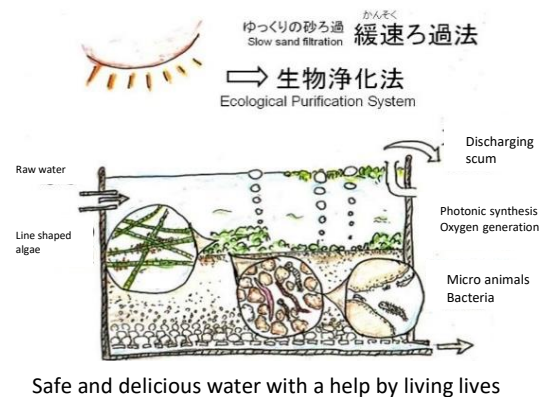


Image of underground water intake

In Okinawa's remote islands such as Miyako in particular, water resources are scarce. So, we have established: water resource management such as water purification treatment that reduces biological purification environmental loads from water source conservation in a limited land area; water supply technologies; and water supply management (operation management). In addition, technology and know-how for building a recycling-oriented society, such as the active use of renewable energy, have been cultivated.



International Cooperation of Companies in Okinawa  
(Technical support, human resource development, etc.)

- JICA small and medium-sized enterprise overseas business development support project (diffusion/demonstration project) (country: Samoa, sponsor: JICA, trading company · construction consultant in Okinawa)
- JICA grant aid plan reinforcement member (country name: Samoa, sponsor: JICA, construction consultant in Okinawa)
- JICA Small and medium-sized enterprise business overseas support project (Proposal) (Country: Vietnam, Sponsor: JICA, Okinawa construction Industry)

# ④ Disaster prevention measures

## Regional characteristics of Okinawa

- Okinawa has a subtropical oceanic climate, with high temperatures and humidity throughout the year. In addition, the recent typhoon season is noticed by large typhoons, which makes it necessary to take measures to deal with and prevent the occurrence of disasters.



A damage



Another damage

## Current overseas situation

- In countries and regions facing the Sea of Japan, the Northwest Pacific Ocean, the South China Sea, etc., typhoons approach or land every year, as in Japan, and they are damaged not only by strong winds and heavy rains but also by landslides in some cases.
- In 2019, these countries and regions were hit by 29 typhoons, and in the past, Typhoon Yolanda (Philippines: Yolanda) landed in the Philippines in November 2013, causing severe damage due to storms and storm surges.

## Knowledge of Okinawa

- Technologies developed and matured in Okinawa may be used for disaster prevention measures in areas with relatively similar climate and ground.
- In addition, a company has conducted a test installation in Taiwan, a region with similar climate to Okinawa, and confirmed its effectiveness.

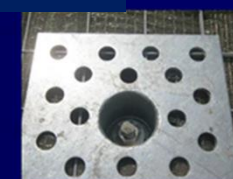
### Pictures showing construction



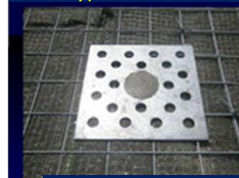
(22) Sheet installation (SP type)



(23) Welded metal net installation



(24) Concave type plate installation



(25) Head process



(26) Construction finished



Construction finished

### Picture showing monitoring



Two months after the test

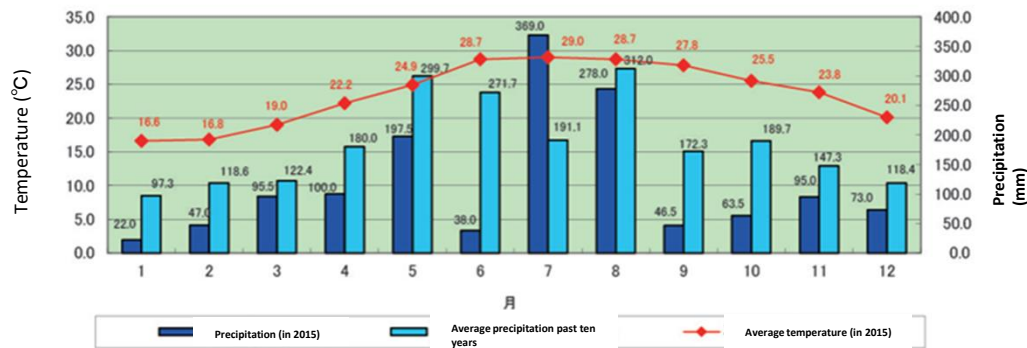


International Cooperation of Companies in Okinawa  
(Technical support, human resource development, etc.)

# ⑤ Houses for hot and humid areas

## Regional characteristics of Okinawa

- Okinawa has a sub-tropical oceanic climate: high temperature and high humidity; the annual temperature difference is small. The temperature is as warm as around 16°C and there are few days below 10 °C even in winter.
- In summer, there are few days significantly exceeding 30°C. The relative humidity is high, but wind speed is high, so you can feel coolness.
- It is also a typhoon striking area, and the wind is strong throughout the year. Rain falls relatively a lot in seasons other than the rainy season as well.
- In addition, because of its low latitude, the elevation to the sun is high and the ultraviolet rays are strong.



Source: Japan Meteorological Agency "Weather Statistics Information (web site)"

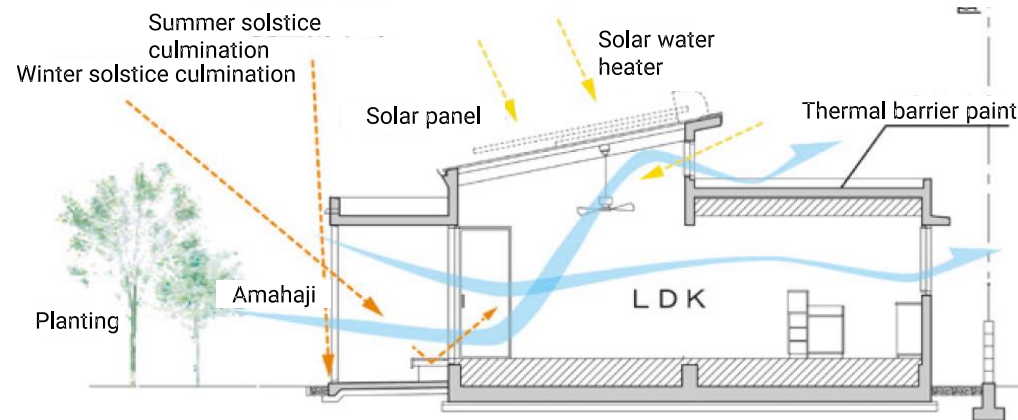
## Current situation abroad

- In areas with rapid population growth and significant economic growth, there are concerns about rapid increases in energy consumption.
- From this also, the need of housing that provides comfortable living even in hot and humid regions that considers energy conservation is deemed be large.

## Knowledge of Okinawa

· Various know-how in consideration of the hot and humid weather has been accumulated in companies in Okinawa.

- ① Traditional architectural form suitable to hot and humid region (contemporary combination of classical form such as Amahaji)
- ② Aluminum fittings and storm sheets for typhoon measures
- ③ Construction technology (carbon fiber sheet, etc.) relating to restoring deteriorated and old-fashioned RC houses exposed to ultraviolet rays, salt damage and humidity for many years
- ④ Maintenance technology such as Okinawa's unique rooftop waterproofing and outer wall water repellent coating
- ⑤ Measures against termites and other pests (boric acid type, bait method, etc.)
- ⑥ Utilization of building material such as Ryukyus glass which colors strong sunlight



Reference: Design Guidelines for Self-sustaining Cycling House for hot and humid regions

International Cooperation of Companies in Okinawa  
(Technical support, human resource development, etc.)



# ⑥ Investigation plan by utilizing ICT

## Regional characteristics of Okinawa

- Since Okinawa has a high temperature and high humid climate and flying salinity, etc., its infrastructure deterioration speed is fast; and efficient infrastructure inspection technology is necessary.
- There is a demand for a damage detection in the event of disaster such as typhoons with large and strong forces approaching and landing several times a year.
- Furthermore, there are many Ryukyu limestones originating from corals, and falling and collapse of rocks repeat in the sea cliffs formed by weathering and wave erosion; therefore, a safe survey technology that reduces human work load is required.



A collapsed bridge by aging



Utility poles collapsed by typhoon

## Current situation abroad

- Since the situation in island countries such as Southeast Asia and Oceania are topographically and climatically similar to Okinawa, the needs for the above infrastructure inspection technology, the immediate damage grasp, response, and the safe investigation technology are also highly required.

International Cooperation of  
Companies in Okinawa  
(Technical support, human resource  
development, etc.)

## Knowledge of Okinawa

- In Okinawa, there are companies that possess ICT-related technologies and equipment that can be used for infrastructure inspections and to assess damage in the event of a disaster.
- In addition, the government is promoting the use of ICT at construction sites for the purpose of improving productivity, and further development of technology is expected in the future.



Aerial photography by drone



Bridge inspections using drones



Information gathering on disaster



3D model by drone aerial view



## Major technologies related to construction industry making full use of the knowledge of Okinawa

① Red clay flow-out prevention measures, environment conservation



② Salt damage measures, extending infrastructure service life



③ Water supply, water purification



④ Disaster prevention measures



⑤ Houses for hot and humid areas



⑥ Utilization of ICT



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Until now, the construction industry in Okinawa has accumulated technology and know-how in response to regional characteristics. There is a possibility that the technology and know-how cultivated in Okinawa can be utilized in areas with similar issues and areas that are topographically and climatically similar to Okinawa.

Areas with similar issues



Okinawa Prefecture

