ABSTRACT: Nowadays China town planners are reconsidering design strategy against the overheated urban growth, in order to match the increasing trends on green transformation. As practice, an urban design proposal was made for Weizhou Town, which suffered a heavy devastation in the worst earthquake in 2008. A green transformation was essential to the town, not only for its current crisis but also for a long-term development. Against this background, this paper is an attempt to introduce design methods used in the Weizhou Town reconstruction project with both a subtractive and an additive consideration. The concept of “Subtraction” was based on the survey and analysis of the existing town space so as to determine what should be taken away in order to achieve green renewal requirements. The concept of “addition” was also implemented for green updating, making the new growth for the town into a sustainable process. This article takes this as an example to highlight the importance of changing traditional ways in which urban design always focused on growth, meanwhile presents this subtraction-addition perspective as an inclusion for green urban design strategy through Weizhou Town reconstruction practice.

KEYWORDS: urban design, green transformation, subtraction, addition, reconstruction after earthquake

1 CITY GREEN TRANSFORMATION AND GREEN URBAN DESIGN IN CHINA

So far the idea of “Green City” has been widely embraced throughout the world for urban sustainable development, which increases requirements on the matched urban design approaches. Over the course of fast urbanization in the past 20 years, the problems stemmed from China’s urban planning and design process have emerged to be intuitive. In the past decades, planners in China mostly focused on incessant additional works, created thousands of man-made environments but at the same time, resulted in the disappearance of green space and the deterioration of living quality.

Taking the experiences of green transformation from the West, more and more cites in China were diverted to the regenerating roads, discarded the radical growth like the past. Paying attention to the gradual changes in the urban space, their transformations are more rational and integrated with greatly emphasis on the co-ordination process of environmental, economic and social development[1].

As an important approach to fulfill the green transformation idea, green urban design study is currently a hot issue, also in wide and different discussions. But the core concept of green urban design has been achieved with consensus in the followings: the design focus on the protection of natural elements, make well control on growth process of urban spaces, green technologies are promoted as the effective tools in architectural design[2]. Overall, green urban design is at the basis of the traditional urban design, more focusing on the harmonious relationship between artificial systems and natural systems of the city, taking sustainability as the highest pursuit through design process[3].

2 THE TRANSFORMATION FOR WEIFEIZHOU TOWNSHIP AFTER WENCHUAN- EARTHQUAKE
2.1 Introduction

As the county seat of Wenchuan, the township of Weizhou is 146 kilometers away north of Chengdu City (Fig. 1) and located at the intersection of Min River and Zagunao River. Built along a riverside with altitude 1325 meter, Weizhou is a typical valley town, situated in cramped space, surrounded by mountain chains, and facing deep valleys. However it is also distinctive for “mountain-water” landscape (Fig. 2). With 1,229,100 square meters of area and a population of 23,000, Weizhou is the center of Wenchuan county and Aba prefecture. It has been an economic hub for resources exchange within the northwestern region and a traffic artery with two state road lines passing through it.

Unfortunately, the town suffered serious losses during the "512" earthquake in 2008, an 8.0 Richter scale earthquake that shocked the entire world. Big threats arose, including potential geological disasters to arable lands and built environments thus surely causing an extremely tense for man-land relationship. The town was trapped in a deep crisis, due to both the outside impacts from the earthquake and long standing inside problems, with public and municipal facilities completely destroyed (an 85.49% of all town buildings), urgently calling for reconstruction help. However, it was also facing a potential rebirth opportunity from the post-earthquake reconstruction.

2.2 Reconstruction after earthquake

Dating to the end of 2009, Weizhou began to recover her vitality after several spearheaded stages were launched, and completed one and a half years after the disaster. The first stage was the earthquake emergency rescue efforts. This occurred primarily through pressing responses and rapid implementations to reopen roads and consolidating mountains, build temporary transitional housing, rehabilitate town’s infrastructure (electricity, water, etc.). These efforts contributed to vanquishing chaos that resulted from the big disaster. Subsequently, the regional plan of Wenchuan County was started, as well as master plans for the 13 internal towns, which adjusted their positions on developing a strategy according to the overall coordinated plan. This led to the second phase, the initial recovery, based on the stability achieved from the first step. From
understanding the role in the overall county plan, this phase helped Weizhou identify its advantages and disadvantages and shape initial developing ideas after post-disaster assessment on the geological condition. At the same time, it enabled city planners to finish the restoration and reconstruction on the city’s scarce hospitals, elementary schools, and residential housing, within a short time frame.

2.3 Transformation Requirements

The sustainable transformation would be the only choice for Weizhou town to get revival from the deep crisis after earthquake and from the backward developing mode in the past century. The chaos from the earthquake and urgent plans created a high degree of difficulty for future post-disaster transformation, especially with regard to the urban design work under such an abrupt and transitory situation. While it achieved considerable successes in facilities recovery, reconstruction work ran into problems, including:

(1) Town space

As a common western small town, the layout off Weizhou Town was already in disarray before the earthquake, due to a lack of systematic and holistic planning consideration. This was greatly aggravated after the big disaster, as the post-disaster initial reconstruction, which focused on rebuilding buildings in various urgent functions, had little ability to control the entire form in this difficult situation, especially within a very short time. The town was seriously disordered, due to a large amount of weak buildings and construction sites (Fig. 4).

(2) Infrastructure

The earthquake thoroughly damaged the ecological system of Weizhou, demolishing vegetation, green land, and river ways, while at the same time destroying the city’s transport system and its necessary living facilities. Although the one-year construction work strengthened and highlighted the city’s living functions, it was still far from the real revival that was needed, especially with regard to the lack of rehabilitation of the eco-infrastructure and the reasonable integration of urban facilities to support long-term development.

(3) Resources

On the whole, Weizhou was situated in an area with natural beauty and an alpine type topography, divided into three parts by two rivers (the Min and Zagunao rivers) and surrounded by three mountains (Yu Lei, Buwa, and Longyang). However, no consideration was given to these natural advantages when shaping the
city’s local distinguishing features. Furthermore, no concern was given with regard to landscape design along the riverbank. Potential waterfront spaces were abandoned by individual developments in two opposite zones, where there were little integrated plans to utilize the town’s water-mountain resources.

3 URBAN DESIGN TOWARDS GREEN TRANSFORMATION

It was in a special situation to concern urban design in Weizhou town, which was largely constrained by its local terrain and the injured environment. Losing a possibility to keep the large-scale expansion mode but facing a more realistic choice to tidy and update within the limited areas, the design mainly took subtraction and addition as two folds to progress green transformation. Subtraction could firstly play a key role in the restoration and reconstruction formulating solutions to town’s disordered form. Secondly, as the natural environment was terribly destroyed by the earthquake, the addition on green infrastructure would be the foundation for the next generation development[4], that emphasize the increasing on parks and greenings inside the town, also be integrated with other additions. Overall, it strongly required on the effective adjustment on existing space and giving free rein to self advantages for new space shaping, with well utilization in subtractive and additional design consideration.

3.1 Subtractive Approaches in Urban Design

Based on the informed research of geological hazard (Fig. 5) assessment, past governmental planning at different levels, and the tentative practices in the first-stage of reconstruction, this study was greatly cautious and precise, first carried out a thorough investigation and an extensive assessment of the entire current environment of Weizhou Township (Fig. 6). This information was compiled into a key database for the design work [5], and included the survey on construction quality and the statistics for building height and land use density(Fig. 7-9).

![Figure 6](image6.png) Town Tissue

![Figure 7](image7.png) Constructed quality on buildings

![Figure 8](image8.png) Building height

![Figure 9](image9.png) Density and land-use
The following key factors affect the future sustainability of Weizhou. The subtraction of design primarily conducted an elaborate re-assessment of these factors in order to lay a foundation for future green reconstruction work[6].

(1) Disaster Prevention
In order to avoid landslides caused by earthquake aftershocks and potential damage from flying rocks, this subtraction plan draws out a 20-meter wide buffer zone along the foot of the mountains, thus enforcing the need to remove all construction inside this zone.

(2) Quality Examination
A classification was made dividing the existing buildings into four categories as determined by the quality and type of each structure, such as frame structure, masonry structure, simple structure, and wood structure. According to the structure’s capacity against seismic shock, the subtraction plan recommends that weaker structures, such as simple and wooden structural buildings, be dismantled.

(3) Landscape Shaping
Due to lack of effective planning and governance in the past, Weizhou Town was in a terrible situation with regard to cluttered building fabric and blocked urban space. Using the subtraction method, spaces along the riverbank were sifted together, based on an examination of construction quality, which was even expanded to the buildings as street facades, in order to create a nice view for the city’s mountain-river landscape and shape open space venues for street walking and visiting.

(4) Micro-space Improvement
The subtraction method also addressed the issues of over-congestion and obdurate urban internal space. This method recommends the appropriate removal of some existing buildings, which were improperly sized or incongruous with the urban texture. The subtraction involved changing some intensive building groups into an enclosed shape, formatting positive open space among groups and units, and preparing an evacuation site, should the city suffer disasters in future.

Figure10  Subtraction process in four filters
Through the above four steps (Fig. 10), subtraction in urban design was completed, delineating the scope for the urban space and identifying specified buildings. The remaining buildings, and those identified for in-situ redevelopment, were identified with a red line (Fig. 11), indicating their removal as part of the green
urban design approach.

![Building for Maintaining](image)

Figure 11 Subtraction for town space, site plan

3.2 Additional Approaches in Urban Design

(1) Greening system (Fig. 12)

Because Weizhou’s current green space system was weak, both in quantity and quality, not to mention landscape effects, the design put four ecology-themed zones from the idea of city ecology, thereby seeking a continuous green embracing environment in order to formulate a secure and pleasant living space. Green fields are a key infrastructure element to fulfill a sustainable city[7], thus this plan added several components, including the following elements, in order to shape a systematic project.

- Cultivate forests to restore the collapse of mountain forest cover and, as far as possible, to restore the native forest and native species, and improve the area’s ecological value.
- Increase the number of city parks to five, with priority given to the city set off in the green gardens, to enact an eco-city strategy.
- Enhance protective greening by setting a number of isolated green belts on both sides of the crossing highway to protect the landscape; doing so will also reduce dust and noise and the effect of pollution on residents’ lives.
- Raise sub-green fields, such as arbors and shrubs, so these can become the principal plants inside the town, in order to increase the shading rate and improve the ecological value of Weizhou.
- Develop agricultural areas to retain existing parts of the farmland, and the economic forest and to actively develop certain grades of landscape agriculture.

(2) Water system (Fig. 13)

Named from the Wen River, Wenchuan has a special relationship with water, since ancient times. Now the river is still like the veins of Weizhou and plays a key role in city’s future sustainable rebirth. Focusing on city’s water system, the addition portion of the plan was to create a continuous, open, and shared water system in order to improve city’s environmental quality, to enrich cultural landscapes, and to ensure urban habitability, with a strong hope that the town and the water would represent an organic integration with wonderful scenery and high vibrancy.

- Bringing the river into the city: Contributing the well flows of river into the city, water system was developed internally to make the town graceful and spirited, surrounded by water. Relying on the existing Min
and Zagunao River, urban design consolidated and improved the overall spatial pattern of the two rivers, while at the same time using the flowing water to form a new town pattern surrounded by green water through the diversion projects on Yu-Lei Mountain. Furthermore, inspired by the renowned local landscape of Jiuzhaigou Pearl Beach in Aba, the design added three small waterfalls into three key areas, formulating a series of scenic ladder cascades and adding natural landscape into the town’s environment.

- Developing waterfront space: Currently on most of the riverbanks, water and green space were separated by concrete protecting slopes and clay aisles, which made the riverbanks dull, hard, and separated clearly with water. This seemed to indicate that the town was a strange place with no hydrophile, even though water was nearby. To remedy this, the plan redesigned the details of the city’s waterfronts around which the “Min-River City Park” was to be constructed, a place that fully demonstrated the fresh and green natural features of the Min River. Waterfront design with multi-level approaches in the “Point, Line and Side” division also placed water at its core, which sought to build a continuous landscape beside the water, and provide rich public space with a series of hydrophilic greenings and squares to meet people’s needs for leisure, fitness, and recreation. To create a city belt with a good atmosphere for tourism, sports, and entertainment, the design also developed waterfront spaces for the public to enjoy, enhancing people's warmth for, and sense of belonging to, their waterfront city.

(3) Disaster responding and rescue system (Fig. 14)

This plan’s addition method especially emphasized a new system for coping with potential disasters. Following a experience that evacuating within 200 meters (the utmost disaster escaping distance) from the Japanese cases on earthquake prevention[8-10], the detailed plan in this paper controlled the systematic combination of green and square to establish an evacuation site, using 200 meters as radius. Addition on this system also emphasized maximum utilization on existing school sports fields, urban squares, parking lots and centralized greenings and waterfront venue to layout these emergency evacuation sites, together with the setting on primary and secondary roads as evacuation and rescue pathways.

Further addition in the future would include the enhancement of water, gas and electricity supplies as lifeline projects[11] in order to strengthen the securing and recovering capacity against disasters. Moreover, this would be expanded to the establishment of a center command base, fire alarms, emergency repairs, medical care, and communications delivery.

![Figure 12: Greening system](image12)

![Figure 13: Water system](image13)
Based on the master plan, the design proposal in this paper introduced addition with regard to the appropriate increase for transportation, especially adding tributary system in order to create abroad ranging network to provide an efficient transportation system [12].

Taking parks as a core element, the addition method also unified other internal public spaces, such as streets and squares, to constitute integrated urban walking system, providing a good urban path for all citizens. By perceiving elements, such as edges, nodes and landmarks[13], people could be able to enjoy a beautiful view, as they travelled and relaxed in the urban built environment, and recognize a green and modern renascent Weizhou town.

Striving to build a healthy and comfortable living environment, modern green buildings are in pursuit of the harmonious development of people, architecture, nature and society by reducing the consumption of natural resources and maintaining energy to weaken the negative impact on the natural environment. This represents a completely new design concept with stylish external appearance and high technology content, creating the emergence of a modern city imagination. This approach has received a broad positive consensus throughout the entire world with regard to the establishment of good, sustainable development [14, 15].

With a demand to gradually rebuild the administrative center, cultural centers, and other public buildings during post-earthquake reconstruction, the addition method used the idea of green building, which played a significant role in notably enhancing urban quality and creating numerous bright points for the rebuilt town.

There were five key landmark buildings in several focusing area, synchronous with the external environment design of squares and parks, within which the design work primarily put green buildings into practices, focusing on new integrated urban pattern for building and for open space. Meanwhile, the transformation of some old buildings also considered adapting green methods, adding continuous green space on the roofs and epidermis of these older buildings along Weizhou’s central road (Fig.17-18), in keeping with the proposed green transformation and new eco-mode creation.

3.3 A Perspective: Rethinking on Subtraction-Addition Approaches in Urban Design Process

The urban design work in Weizhou provides planners with a deep understanding: firstly subtraction was the breakthrough that be used to restore the deteriorating town space in response to a land shortage after an earthquake. The subtraction was to comb the gray space and change the confusion of its form as a complement to the formal fast reconstruction, leaving room for the future follow-up green improvements. To treat the situation of ecological deterioration as a serious threat to town security, the addition approach must be
applied to optimize the environment and integrate the eco-system and disaster-responding system. The addition in reconstruction does not simply involve quantity increasing. It should enable the real return on urban quality. The addition should be implemented using a variety of new elements based on a clear-cut outline to gradually raise sustainable growth on a broader platform for the town. The implementation of sub-add approach could contribute a new mode of thinking on green urban design, and also provide a broader platform for the town’s sustainable development in future.

![Figure 16](image16.png) New green buildings integrated with green open space

![Figure 17](image17.png) Building Green regeneration

![Figure 18](image18.png) Green façade for city avenue

### 4 CONCLUSIONS

Under the post-disaster reconstruction opportunities, Weizhou had chance to take a green transition led by planning policy and guidelines, eagerly required on effective green urban design to reshape town space. Facing large difficulties in the post-disaster situation, urban design took the subtraction-addition perspective for a sustainable transformation, recalling balanced and parallel works for both cautious deletion and organic growth, for whose relationship should be also explored with more research and practice.

This urban design emphasized the gray space removal and the green system increase within the limited town area. Established by multi-level analysis on sorting out the existing complex built environments, subtractive method were taken as effectively tool for space hackles, eliminating gray parts as a foundation for green space creation. At the same time, the design integrated several elements of green system through additional method, in which green spaces, water system and green buildings were the main focus as the benign catalysts for the green city transformation. The design also reflected a priority issue, from its first advocation on the removal of negative buildings to the last step of adding new green buildings, that the artificial construction should give place to the overall natural environment, which would to be a deeper indicant for future
green urban design practice.

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