Research on Design Scheme of Sponge Campus Construction--A Case Study of the New Campus of Guangxi Polytechnic of Construction

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Abstract

Nanning was actively constructed into sponge city combined with the construction of new urban district. Campus should be easier for cavernous transformation in public because of its special nature. Road construction and pipeline renovation "line" reconstruction was not conducive to sponge city construction. There should be fully cover of implement production and living space by point, line, face "sponge" to make city "breathing" smooth like a sponge. Based on the field survey of the new campus of the vocational and technical college of guangxi, this paper had made a reasonable design plan under the design conditions of 85% of the total runoff control rate.

Keywords

Sponge Campus, Design Scheme, Case Study.

1. Introduction

The project is located in the urban northwest of pilot demonstration area of construction sponge city Nanning Guangxi, and north of North Xiangsihu road, west to Luowen Avenue, east of Guangxi University for Nationalities. The project covered an area of 8.64 hectares (86400 ㎡). Based on site investigation, the regional rainwater was used directly, when some rain storm runoff directly through the existing system to the municipal administration. The design area involved the part had been used which was in the northwest corner of the campus, covered an area of 6 hectares. According to the geological exploration report, this region was divided into the top three engineering geology layer respectively: miscellaneous fill soil (permeability coefficient 1 m/d), sand layer (permeability coefficient 7 m/d), and pebble layer (permeability coefficient 150 m/d).

2. The Target Index

This paper had determined the target index of campus sponge according to "Technology Guideline of Sponge Urban Construction--Low Impact Development of Rainwater System Build (trial implementation)" and Sponge City Special Planning, etc., combining with the site situation and analysing the status quo, runoff data characteristics. The target was mainly includes the control of rate of the total annual runoff, rate of the pollution reduction runoff and rate of the water resources utilization. The construction of leading indicators were including the rate of green sponge, rate of permeable pavement and rate of green roofs, etc. According to the actual situation, the sponge city construction planning of this project was to achieve the comprehensive utilization of rainwater for: in return period for two years, rainfall of 42.6 mm (total runoff control 85%) design conditions, the local block would not generate the water draining.

3. Project design

3.1 Overall design

The overall design scheme was the basis of the design of sponge scheme combined the characteristics of campus, which mainly included the division of catchment partition, the layout of the sponge facilities and the vertical design of the sponge facilities.

3.1.1 The division of catchment partition.

Delimiting campus water catchment area and determining the flow direction of the catchment area according to the analysis of the conditions of the underlying surface of the campus, the vertical conditions, the rain drop tube, the outdoor rainwater pipe network, combined with the site survey situation, function zoning of the campus and runoff characteristics. Sports area, teaching area, office area, dormitory area, road system, and canteen and parking area and other functional areas were divided into separate watershed. Part of the catchment area which was larger than others or with a more complex the drainage path were refined into the catchment according to the vertical. The control objectives of catchment partition of this project were shown in Table 1.

Table 1.The control objectives of catchment partition

Catchment partition	Catchment area F	Rainfall Q	Comprehensive Runoff Coefficient ψ_z	Designed Control Runoff W
	m^2	m^3	-	m^3
Teaching Area	t	949	0.97	918
Sports Area	3246	138	0.77	106
Office Area	9447	403	0.51	207
Dormitory Area	10387	443	0.54	186
Canteen	2488	106	0.52	55
Road System	8154	347	0.75	259
Parking Area	4001	170	0.6	102

3.1.2 The layout of the sponge facilities.

Determining the sponge facilities location combined with the campus catchment partition, underlying conditions, vertical conditions to clear type, size and function the sponge facilities. Sponge facilities used in the campus included biological detention pool, high flower beds, rain garden, planting grass ditch, pervious pavement, wet pond, vertical greening, green roof, small wetland, reservoir, ecological tree pool, farming garden and so on.

3.1.3 The vertical design of the sponge facilities.

Based on the vertical design of the site, calculating the height of the spillway and the blind pipe, the relative elevation of the top of the sponge facility and the green space, and ensuring the rainfall organized convergence and transfer to the sponge facility in the catchment area. Based on the design of the gray drainage system, clearing discharge direction of the whirlpool facilities and the discharge of the pipe. There should be cleared the gray drainage system and the way the campus of the external rainwater interface or discharge in particularly.

3.2 Sponge Facilities Design

3.2.1 Sports Area.

① Taking the safety and landscape factors into consideration, the fragmented green space did not arrange sponge facilities in sports Area. ② Setting up a linear drains along the playground to collect and transfer rainwater runoff to sponge facilities and import them into the reservoir. Laying the gradation packing and the drainage pipe at the bottom of the playground lawn. Rainwater runoff was introduced into the linear drain and pool. ③ Setting up underground rainwater storage facilities around sports area. The reservoir had a certain water purification function and the purified rainwater could be used for irrigation in sports field lawn and scattered green space.

3.2.2 Teaching area, Office area and dormitory area.

① The roof of building with the relatively small slope angle roof and plane roof should be adopted green roof which design should be consistent with the "Roof Engineering Technical Specifications" (GB50345) requirements. The green roof was set to consider rainwater collection and reusing for green roof watering. Flat green roof should be designed into a farming garden, combined with the

practice of natural lessons. ② Sponge facilities were arranged between buildings and surrounding green spaces. ③ Take the safety factors into consideration, the teaching area did not use wetlands, wet ponds and other sponge facilities, which could meet the needs of landscape dry by landscape and other forms. ④ Office area was arranged by sponge with the combination of water features. ⑤ Dormitory area would be used of small sunken square and layout sponge facilities to meet the activities, leisure and learning needs.

3.2.3 Road systems.

① Using ecological drainage; Setting up less underground drainage network in the campus and not setting the curbs. ②Unilateral drainage of the road were arranged in the side of the sponge facilities. Bilateral drainage of the road were arranged on both sides' sponge facilities. ③If on both sides of the road could not be arranged sponge facilities, using linear drainage ditch or grass ditch to organize convergence and transmission of rainwater runoff to sponge facilities. ④Sidewalks and squares were easy to use pavement. ⑤Non-motor vehicle lanes and motor vehicles were used permeable asphalt pavement or pervious concrete pavement.

3.2.4 Canteen and parking area.

①The rainwater runoff is pretreated by planting grass ditch, vegetation buffer or sedimentation tank, and then run into sponge facilities. ②Parking lot was designed for ecological parking lot. Parking spaces were in the form of pavement for the rain runoff into the grass ditch and then into the biological detention pool with water purification function sponge facilities.

4. Partition control calculation results

According to the volumetric method specified in the "Technical Guidelines for the Construction of Sponge City Construction - Low Impact Development Rainwater System Construction (Trial)", the total annual runoff control rate of this sponge program was 86.2%after the implementation, which meets the design target requirements. According to the campus green space irrigation, road pouring, car washing and other miscellaneous water to determine the volume of rainwater storage facilities to calculate the utilization of rainwater resources 76.8% which met the design objectives and requirements. The partition control calculation results showed in Table 2.

Table 2. The partition control calculation results

Catchment partition	Catchment area F	Engineering measures	A	B	C	D
	m2	-	m3	m^3	m^3	m^3
Teaching Area	22281	Green roof, indirect downspout, Vertical greening	918	918	923	923
Sports Area	3246	Linear drain; Reservoir	106	230	108	237
Office Area	9447	Green roof; Indirect downspout; Vertical greening	207	460	209	468
Dormitory Area	10387	Green roof; Indirect downspout; Vertical greening	186	455	222	495
Canteen	2488	grassed swales; Vegetation buffer strand	55	116	68	159
Road System	8154	Linear drain; Grassed swales; Permeable pavement	259	535	266	557
Parking Area	4001	Permeable pavement	102	204	107	219
A The amount of rain needed to be absorbed	B Required facility volume	C The actual absorption of rain	D Actual facility volume			

5. Summary

Nanning City, as one of the Chinese second batch of sponge city pilot cities, had summed up a set of sponge construction experience suitable for climate and geography of Nanning', but because of the funding gap there still need to make persistent efforts. University campus in Nanning is a large gap in the construction of urban sponge, but also a major promote the popular green culture. Therefore, to strengthen transformation and application the sponge engineering direction use of university campus at Nanning City could do a good co-ordination work of sponge construction.

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