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Simulation and Strategy Analysis of the Eco-community Planning by Using of Computer Software Programs

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Abstract: In order to improve the living comfort level of the low-income groups, and the belonging of the affordable housing community residents, the research group take Nanyang green community housing design as the research object, using the computer software for community planning phase of the thermal environment, wind environment, light environment for simulation analysis. The result showed the micro-climate, thermal environment, and adjusting the temperature of the district as well which is the affordable housing community worthy of promotion of green building technologies for small and medium-sized cities. It also provides the reference for the similar project planning in the process of ventilation, lighting, shading, such as green design strategy research.

Key words: Affordable housing, residential district planning, software simulation, ecological strategy, effectiveness analysis

INTRODUCTION

Security housing is a special residential type in Chinese Urban Residential Construction. For a long time, because of its limited size, limited investments and less profitable, government pay more attention to its affordable, the architects' priority attention is the volume rate and real rate, while ignoring the comfort require- ments, green building technology is rarely involved.

Nanyang "Long Xiang Century Home" is located in the northern part of Nanyang City, Henan province, it's the China 12th five science and technology support program-"urban green development of eco-technology research and demonstration projects" technology demonstration District. As a typical case to security housing ecological community research, this project focuses on security housing and community green space ecological building design optimization techniques, Aimed at establish a low energy consumption, consumption, low-pollution, low-emission characteristics of security housing in the medium and small city to provide scientific and technological support of ecological community.

Since 2008, investigation of Nanyang security housing ecological community environment has been done (Du and Gao, 2008; Huang and He, 2009; Yan *et al*., 2010; Yao, 2011; Yu and Liu, 2007; Wang *et al*., 2009). In conjunction with the project planning and design (Zhao *et al*., 2013) to analyze research, with low cost, low technology, suitable for comfort as the starting point.

MODEL AND METHOD

Research tools: ECOTECT green building software is developed by the company of UK Square One research PTYLTD ("Square One"), which is a simulation software, with the advantages of fast, intuitive, highly technical and so on.

It is convenient for architects to analyze the impact of the thermal properties, natural light and artificial lighting, sunshine and building of the environmental by this software, which help architects to evaluate construction scheme in the design stage, or make the comparison about the Pros and cons of different schemes from the perspective of building environment, thus making a better choice in favor of ecology (Yun, 2007).

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This study analysis the thermal environment, air environment, light environment simulation of the design phase of the security housing community planning by using ECOTECT software. By analyzing the results, adjust the design ideas, provide a reference for the similar project design strategy planning process of ventilation, lighting, shading, greening and so forth.

Research object: "Long Xiang Century Home" is located in the Nanyang City, Henan province, belongs to the hot summer and cold winter area in our country the thermal regionalization. Located at latitude 32°17'~33°48', longitude 110°58'~113°49', in 1897.9 the number of sunshine to 2120.9 h, total annual solar radiation of about 4600 MJ/m^2; annual average temperature of 14.4~15.7°C, where the average temperature is 1.2°C in January, 7 monthly average temperature of 27.3 °C; first frost date is November 5, last frost date is April 1, frost-free period 146 days; snow day appeared in early December, the final day in the snow in late February; annual rainfall is 703.6~1173.4 mm, relative humidity is about 73% (Zhao *et al*., 2011).

The community occupies 500 acres of land, planning capacity rate is 2.72, building density is14.78%; total construction area is 670979.32 m^{2}square meters on the ground, facilities of 5768. m^2, including 42 12-storey residential buildings, 24 32-story residential buildings, a primary school with 18-classes, 2 12-classes nursery. Using ECOTECT software to establish the model of community planning, Fig. 1.

Parameter selection: According to the "China Building Thermal Database"in" design of outdoor meteorological parameters" set of the wind environment simulation of initial wind speed and direction, the average wind speed of Nanyang outdoor is 2.4 m sec^{-1}, the maximum wind is the northeast wind (Table 1).

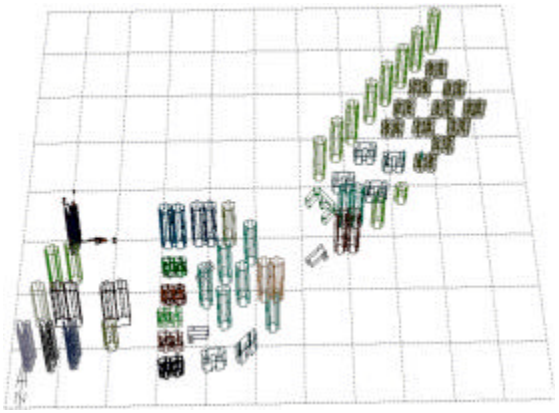

Fig. 1: Community model in preliminary planning stage

RESULTS AND ANALYSIS

Analysis of the best orientation: According to the simulation results (Fig. 2), to ensure the living comfort security housing, the heat preservation in winter and summer ventilation should be taken into account at the stage of the planning and design, the different of the solar radiation intensity received between the buildings in Nanyang in winter and summer, the community of residential buildings' best towards is the South West 15°, the suitable towards is the East15°, to the South West 20°.

Analysis of wind environment: From Table 2 and Fig. 3, it can be seen that the wind velocity ratio of the whole communityis 0.634. Ove rall, the wind environment is good. The wind environment in central and south west area is poor, Mainly because of the south, EastNortheast

Table 1: Community outdoor meteorlogical sparameter

Outdoor meteorological parameters for design	Unit	Nume-rical
Outdoor temperature of heating	°C	-1.8
Temperature of ventilation in winter outdoor	°C	-1.8
Temperature of ventilation in summer outdoor	°C	30.5
Relative temperature of outdoor summer ventilation	%	66
Temperature of air conditioning in winter outdoor	°C	-4.1
Relative temperature of air conditioning in winter outdoor	%	68
Dry bulb temperature of air conditioning in summer outdoor	°C	34.4
Wet bulb temperature of air conditioning in summer outdoor	°C	27.9
Average temperature of air conditioning in summer outdoor	°C	30.1
Average wind in winter outdoor speed	m sec^{-1}	2.4
Average wind speed of the most wind direction in winter outdoor	m sec^{-1}	3.4
Average wind speed of outdoor	m sec^{-1}	2.4
Most wind direction in winter	-	NE
Rate of the most wind direction in winter	%	24
Most wind direction in summer	-	NE
Most wind direction in summer	%	20
Annual Maximum Wind Direction	-	NE
Rate of the annual maximum wind direction	%	16
Atmospheric pressure in winter outdoor	Pa	101393
Atmospheric pressure in summer outdoor	Pa	98777
Sunshine percentage in winter	%	28
Date of heating for design calculation	Day	92
First day of the heating for design calculation	-	29-Nov
Final day of the heating for design calculation	-	28-Feb
Extreme minimum temperature	°C	-17.5
Extreme maximum temperature	°C	41.4

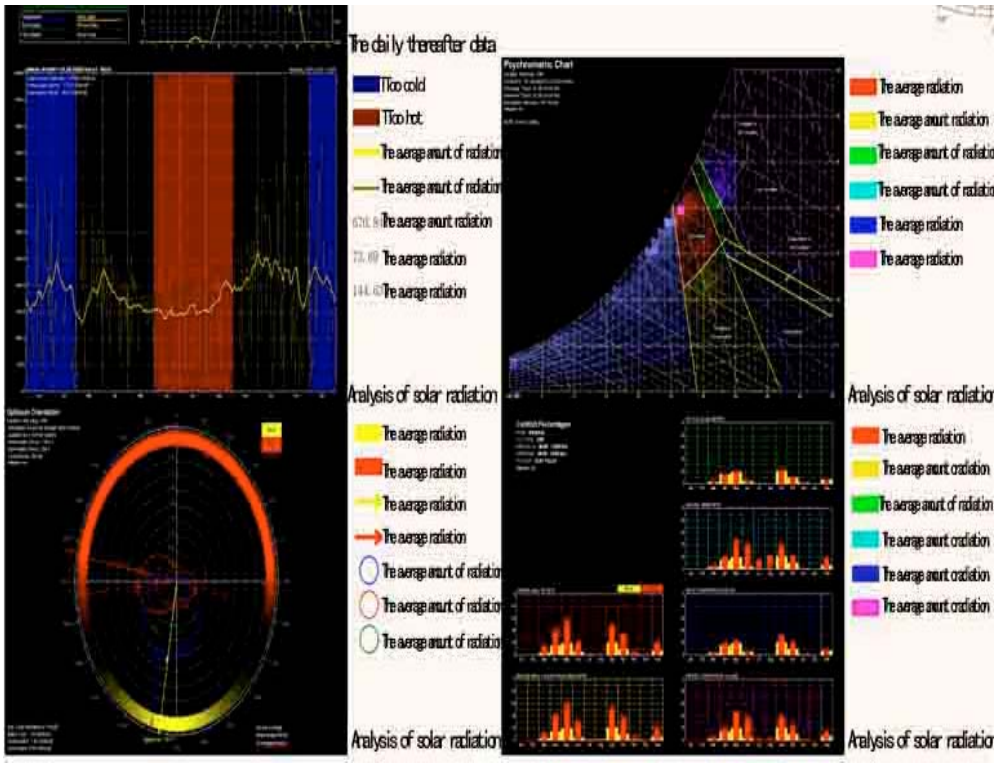

Fig. 2: Nanyang climate impact on community planning

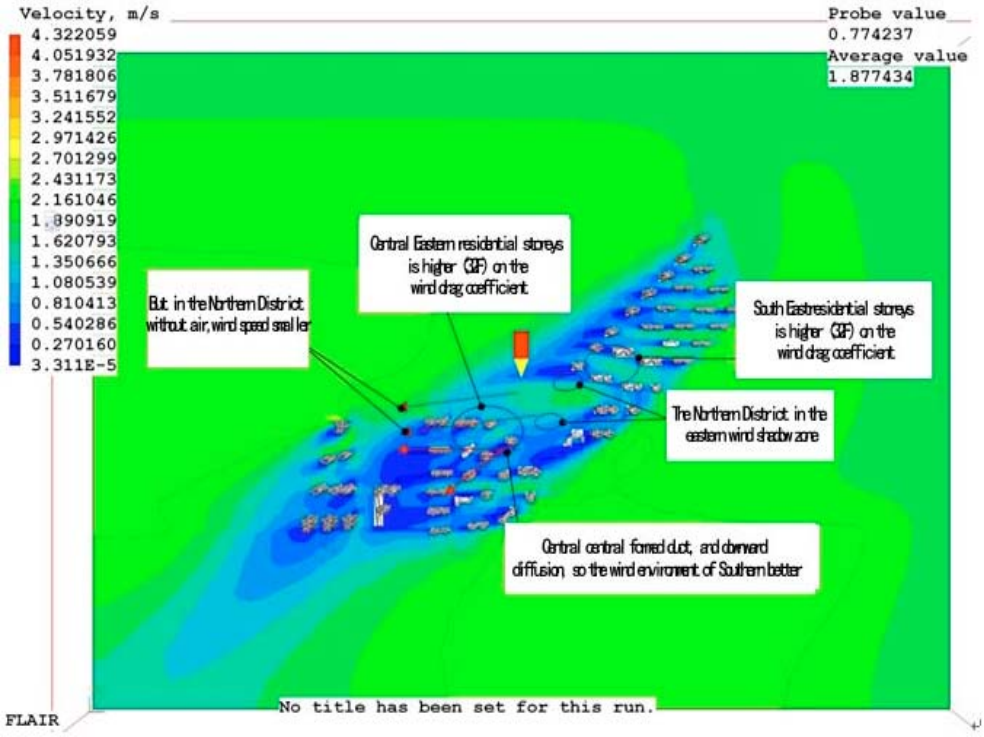

Fig. 3: Preliminary planning community wind environment quality and its influencing factors

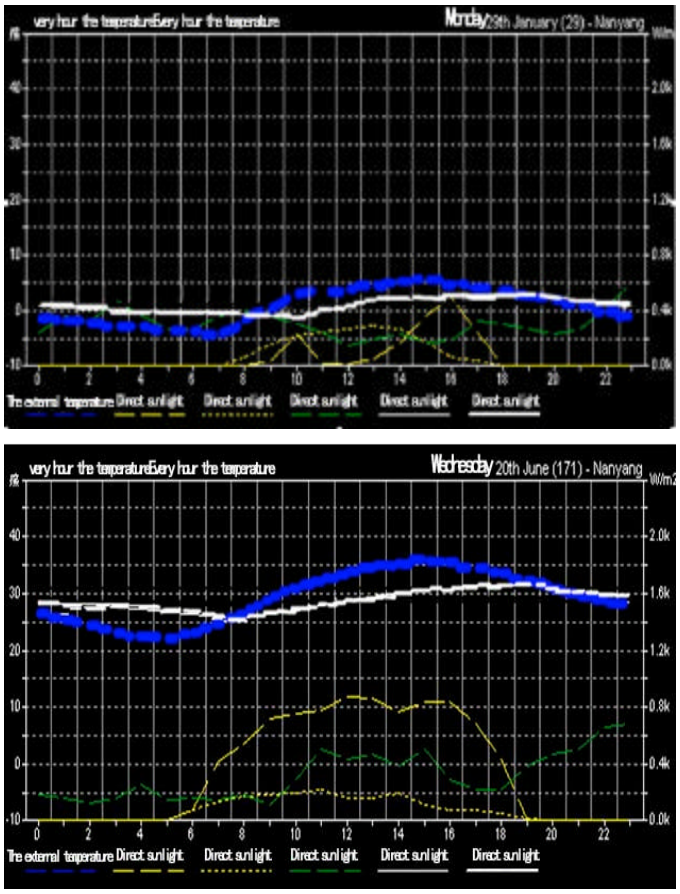

Fig. 4(a-b): Temperature change curve of annual average daily air temperature in preliminary planning, (a) Lowest temperature (January29th) and (b) Highest temperature (June 30th)

Table 2:Community wind environment evaluation

Location	Calculation of wind Speed (m sec^{-1})	Velocity ratio	Valuation results
East area	1.297	0.895	Excellent
Middle area	0.577	0.398	Poor
West area	0.667	0.460	Middle
All area	0.919	0.634	Good

district residential building is higher layers (32F), mainly because of the block to the wind, the buildings should be reduce two layers.

Analysis of thermal environment: Planning Adjustment Strategy. The 6-housesin East South East and Central fall into21 layers, set the sunken rainwater tanks in the eddy current position, to collect rainwater for landscape irrigation in the community. The eddy current sites have a small amount of evaporation, it can be conserved Water sources, to improve the quality of community microclimate and air relative hunidity. By reasonably setting the waters and square, to eliminate vortex and corner, reduce the adverse effects of air on the regional micro environment and building itself, In order to ensure a comfortable outdoor space and indoor good ventilationconditions.

Comparison Between before and after planning adjustment about the thermal environment of community

Figure 4, 5, respectively represent the annual average daily lowest temperature and the highest temperature about one day of hourly change curve, the blue coarse curves in the graph represents the outdoor temperature changed in an intra day, The thick white curve represents the change in the rainwater tank area in an intra day. The simulation software of temperature which is the wet bulb temperature. The different from the annual hourly outdoor temperature changes under the extreme weather conditions can be seen on the map that residential buildings and pool area gathered at the temperature variation is as follows.

The highest temperature in winter was about 6°C, appeared at 2~3 in the afternoon, air temperature was slightly higher than the initial planning of 0.5~1°C, this was because of lowering the height of the part of the

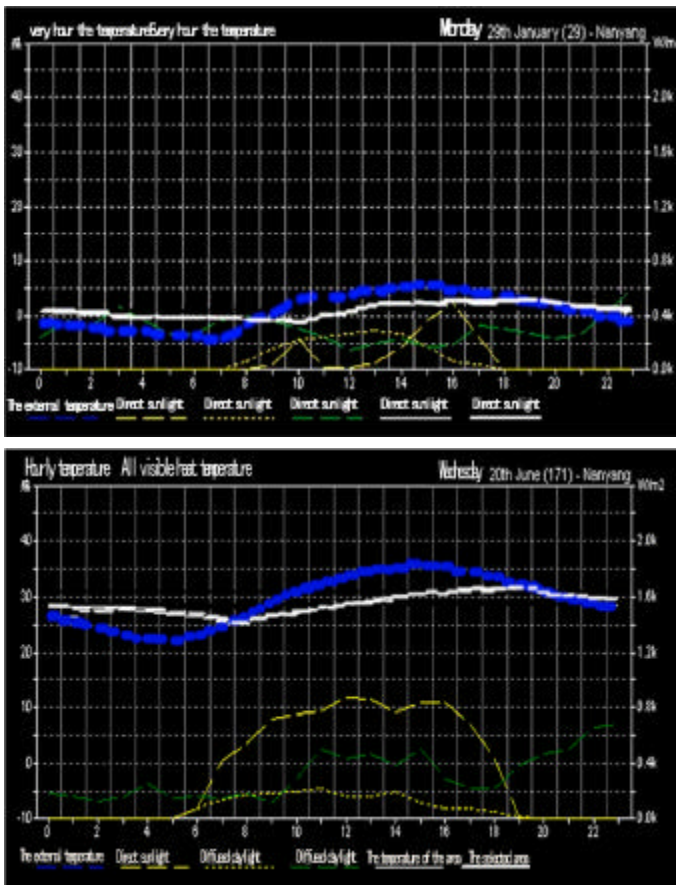

Fig. 5(a-b): Temperature change curve of annual average daily air temperature in planning adjustment, (a) Lowest temperature (January29th) and (b) Highest temperature (June 30th)

high-rise residential, making the sunshine more fully in winter. The lowest temperature was between 6~8 a.m., the temperature was similar with initial planning. Pool regional temperature at night was higher about 0.8~1.0°C than the residential gathered While was lower about 0.8~1.0°C than the residential gathered at daytime.

The highest temperature in summer was about 34.5°C, air temperature was slightly lower than the initial planning of 1~1.5°C, appeared at 2~3 in the afternoon, The lowest temperature is 21°C,was slightly higher about 1~2°C than preliminary planning temperature, appeared between 4~5a.m., it was because of lowering the height of the part of the high-rise residential, to reduce the adverse impact on the natural ventilation, in order to eliminate the dead angle and vortex induced flow. Temperature changed in pool area was gently and was higher about 1~2°C than the residential gathered at night while was lower about 3~4°C than the residential gathered at daytime.

Analysis of landscape greening strategy: Community green landscape can be determined by the solar radiation within in specific period in the field (Fig. 6) , arrange the negative, neutral and positive plant species in the full shade area, half shadow area, half sunshine area, the full sunshine area (Lin, 2004). In the residential buildings around, the place in which the cumulative average daily radiation was less than 3 MJ m^2.d, planting the negative plants species as picea, abies; The house near the road, the place in which the cumulative average daily radiation between 3 MJ m^2.d, to 6 MJ m^2.d, should be planted neutral plants species; Landscape tour area, the place in which the cumulative average daily radiation was more than 6 MJ m^2.d, should be planted positive plants like pine, pinus , formed the complex layer structure ecological landscape together with low shrubs and grass.

Setting the children playground, the elderly activity area and sunshine garden area in the community is the full of sunshine, plant deciduous trees, shield the sunlight radiation in summer, which provides the shade and cool sites for the young and old residents; With the falling of leaves in autumn, the sun will not produce large occlusion in the winter, so as to meet the sunshine requirements of

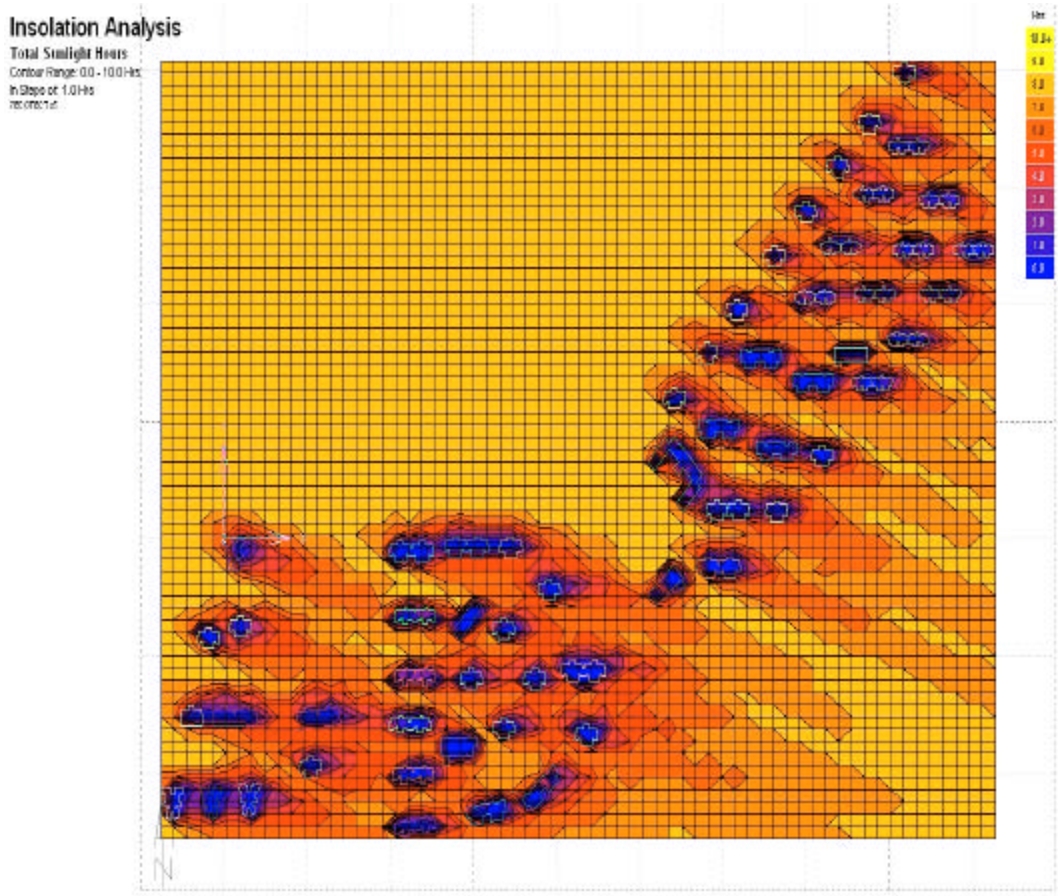

Fig. 6: Community solar radiation analysis

special crowd. Ensured both the temperature cool in summer and warm in winter and combined with local natural climate and geographical conditions, to create a comfortable, energy-saving and ecological living space.

CONCLUSION

Based on the process and result analysis of the simulation above can be concluded as follows.

In the project planning stage with the aid of computer digital analysis, improved the past can only be based on experience or expensive experiments to predict the deficiencies of the design effect, have a very good auxiliary effect of architectural planning design (Yu and Zhang, 2007). Especially in the planning stage, you can compare different schemes of good, timely put forward the improvement measures, optimize the design, reduce the rework rate of engineering.

By reasonable planning and layout, construction of a rainwater collection pool within the community can improve the micro climate within the community and thermal environment, adjust the temperature of the area, especially in the summer when the effect is more obvious. The landscape design of ecological community is not confined to the usability and scenic view, but also change the role of landscape to express the landscape ecosystem and create comfort too (Li *et al*., 2011). Through the analysis of the solar radiation with reasonable choice plant configuration, can balance economic, protection and comfort, small and mediuni-sized cities are based on natural environmental improvement countermeasures, it helps to solve the practical problems in housing construction in our country, build a good ecological cycle of community living environment.

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