Virtual Design World Cup

The 1st Student BIM & VR Design Contest Theme2011 "SHIBUYA Bridge"

Pedestrian Bridge Design-New equipment in urban space-

14 Piers

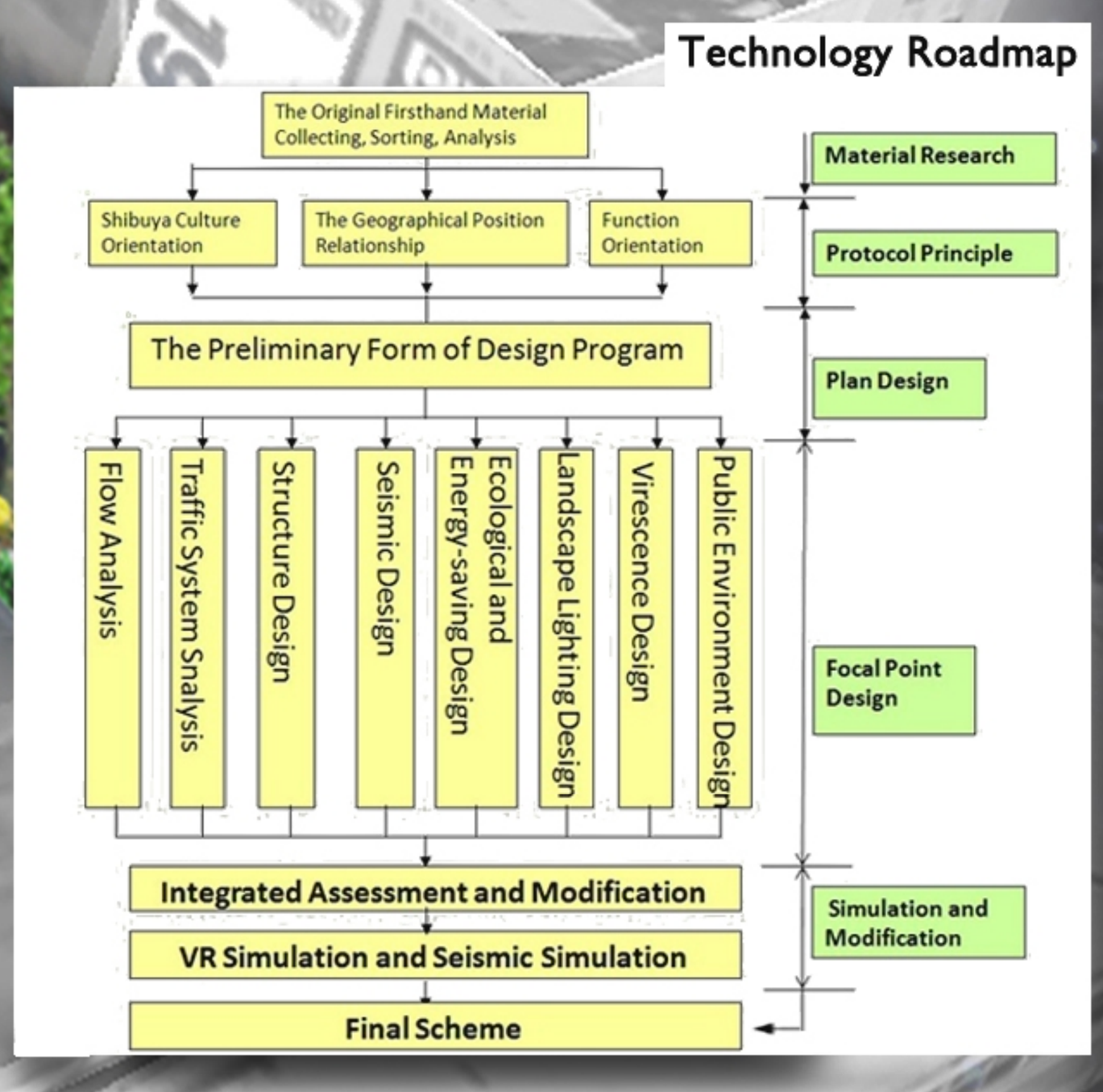
4 Elevators

6 Stairs

4.17 Meters Wide

4.75-8 Meters High

29 Meters Radius



THE OASIS

Symbol of Shibuya in 2012

Location Decision Area B (Miyamasuzakashita Crossroads)

- 1.The build-up of the Hikarie high-rise building will effect the volume of visitors flow of Shibuya moving towards to the east, which has a direct impact to Miyamasuzaka, besides the East Entrance of Shibuya Station has had a pedestrian overcrossing already.
- 2. So far the differential of the amount of traffic from East-west and north-south in Miyamasuzaka is about 3 times, and traffic jams are easily caused. If the vehicles and pedestrians can be mutually independent, the pressure of traffic could be dramatically eased.
- 3. Miyamasuzaka,which has plenty of strong sunlight with no high-rise building in the south and very limited amount of trees, is very appropriate to operate ecological and environmental improvement or reconstruction, and realize the energy conservation and reduce the heat island effect.

Design Orientation

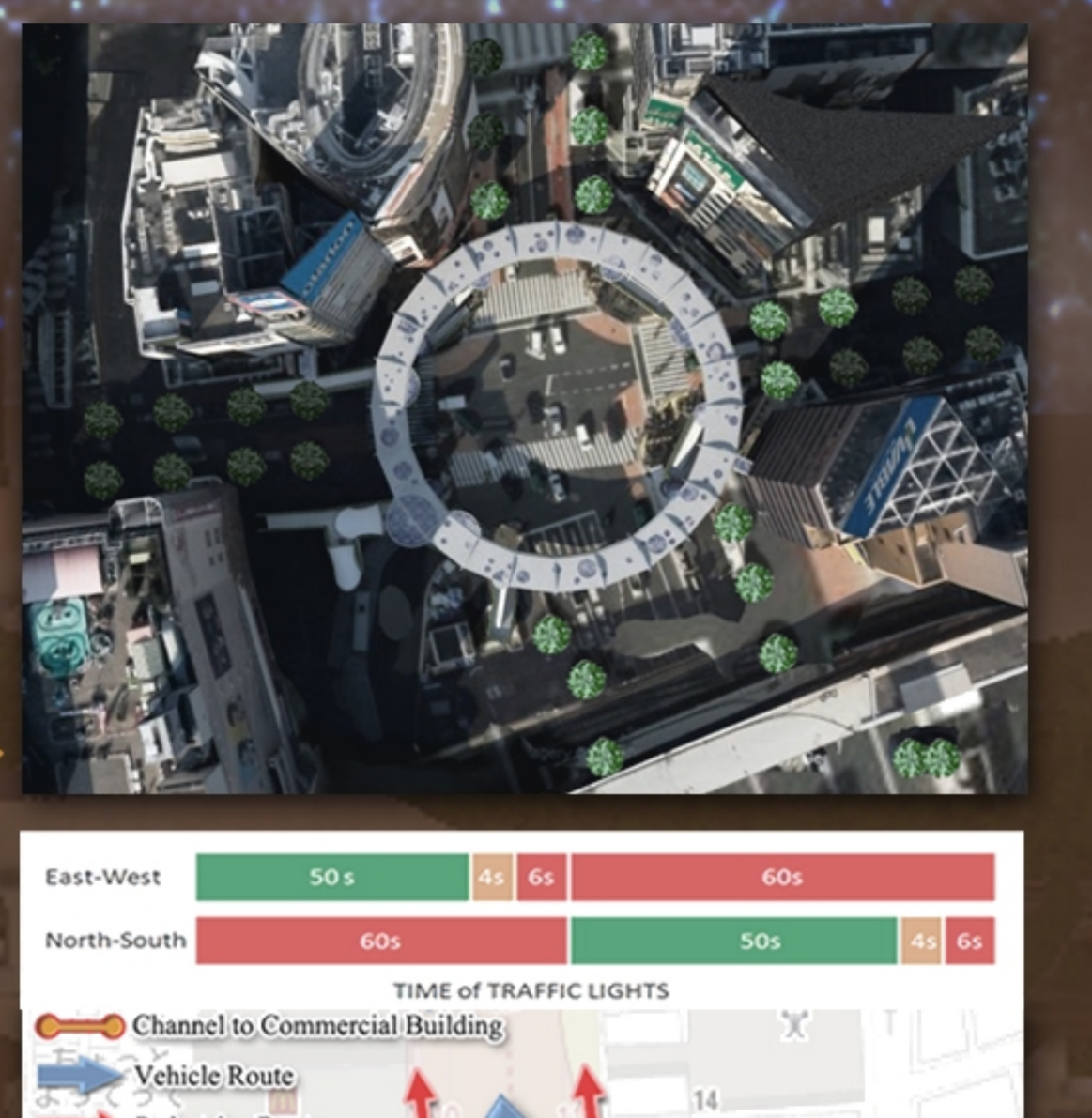
Shibuya Culture Characteristic

Intensive Business Environment

- With comprehensive consideration of the geographical conditions and culture conditions, besides the functional necessities, the pedestrian bridge should be distinctive, modern, symbolic for Shibuya and the most concentrated key point should be the ecological and environmental refreshment, for there is little nature but crowd manufacture surrounded this area. Not only people in Shibuya need an easy access or landmark architecture , but also call for an oasis in their daily lives.

Design Concept

- 1. The consummate shape "O", which does not include sharp edges, has the intimity to natural environment and flexible use of space. Also, "O" stands for "OASIS".
- 2. This intersection of this area B is irregular crossroads without vertical crossed. The pedestrian crossing in the south is 22 meters long, while the three other pedestrian crossings are only 8 to 10 meters long. There is also an additional path in the southwest.
- The ring shape could provide a better connection towards to the irregular surroundings. 3. The Miyamasushita area is crowded and narrow, the ring shape has a good approach to the surrounding buildings. Several channels could be designed accessing to the interior of commercial building directly.



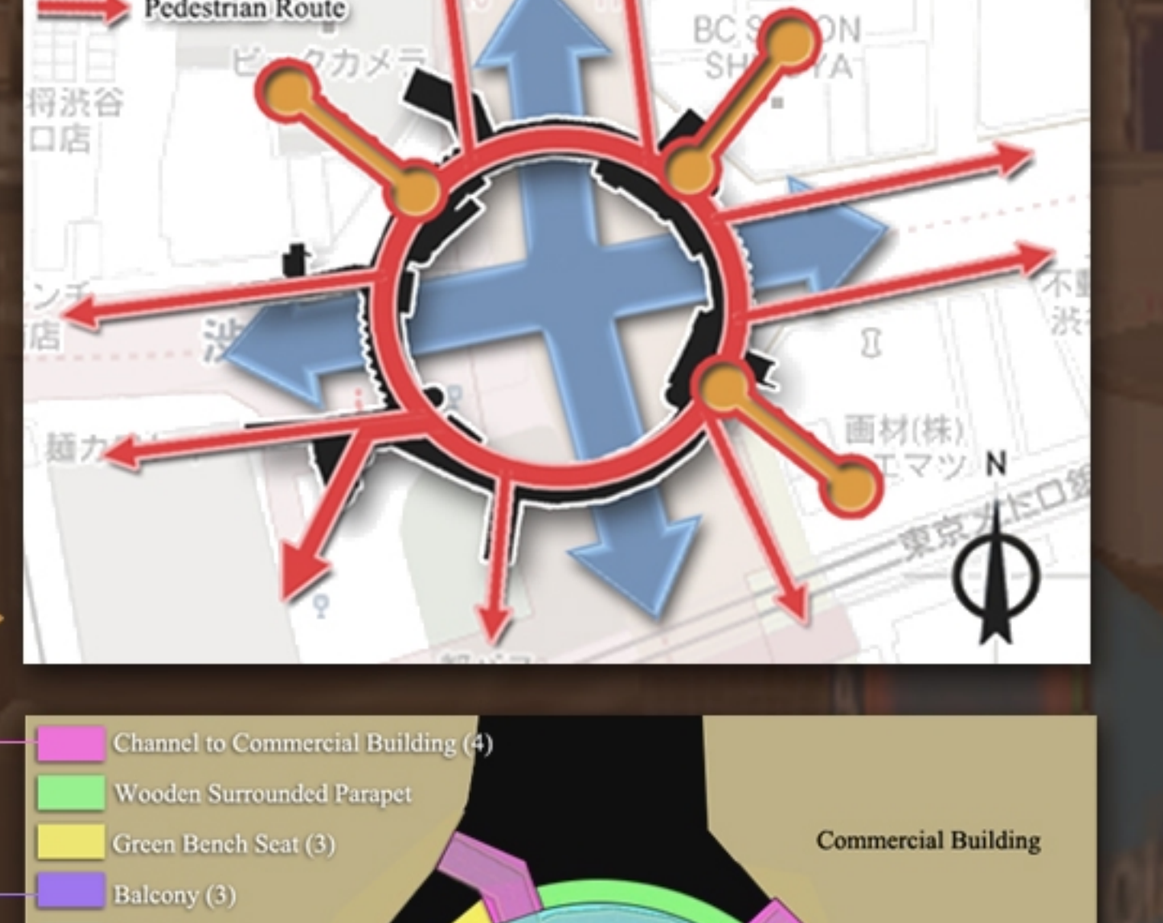
Aerial View

Traffic Division

- Traffic volume data in Oct, 18th (Tuesday) From 6:52 to 7:40(non-working hour), from 9:43 to 10:04(working hour).

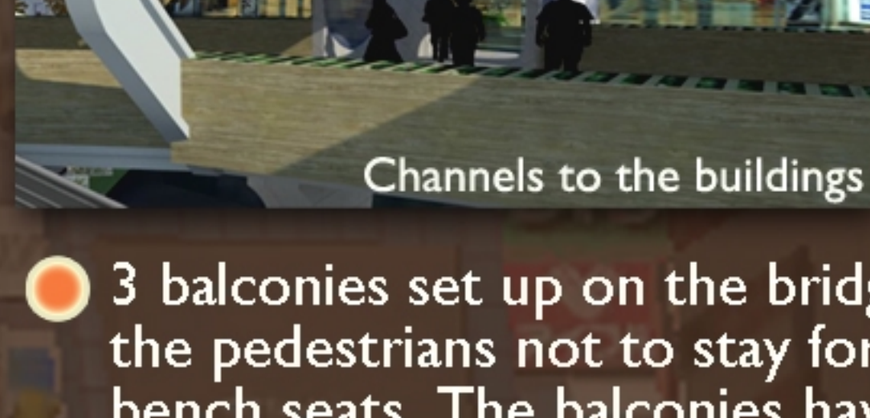
N & S	17	30	23	27	27	21	33	26	37	29	29	28	35	36	39	31	34	29
E & W	6	5	4	6	6	4	10	10	12	7	9	12	11	10	14	12	15	10

- The prediction of traffic volume can be calculated briefly as 600/hr (E & W) and 1500/hr (N & S). And traffic jams occur frequently from about 10 o'clock, some of the vehicles have to wait 2 turns to drive through. The delay gets much worse when the pedestrian involved occupies the green-light time for vehicle.
For the pedestrian, from Shibuya Station to another side, the OASIS provides a half-minute-distance on foot, which simulated in the UC-Win/Road, reducing almost 50% time compared with before.



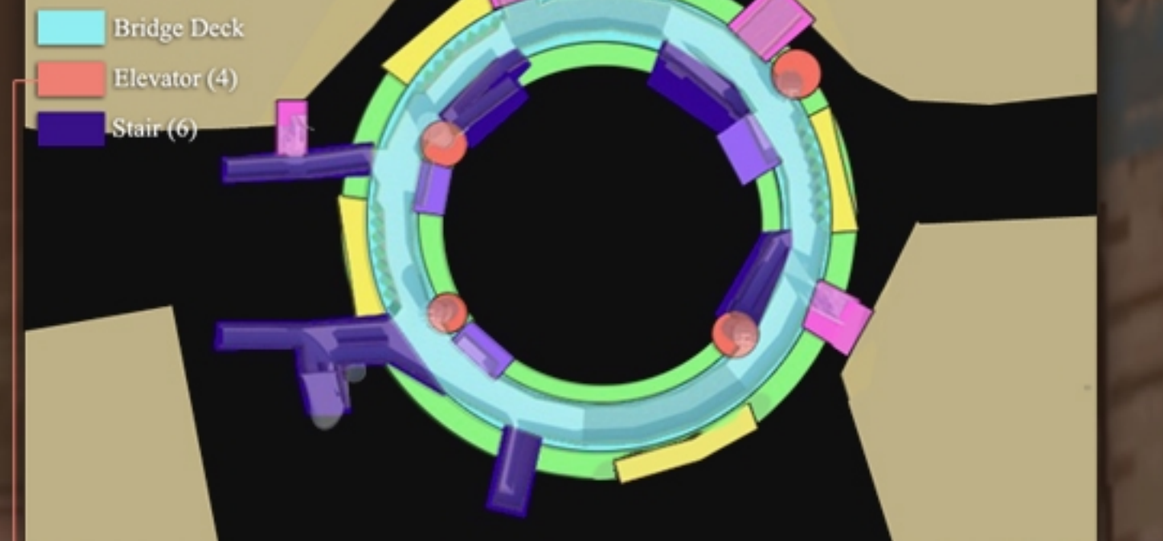
Traffic Flow

Sectorization



Channels to the buildings

- The 4 channels on the bridge connect the bridge to the interior of the 2nd floor of commercial buildings, which provide people more convenience to the access of individual destination, also could distribute the pedestrian flow dramatically .



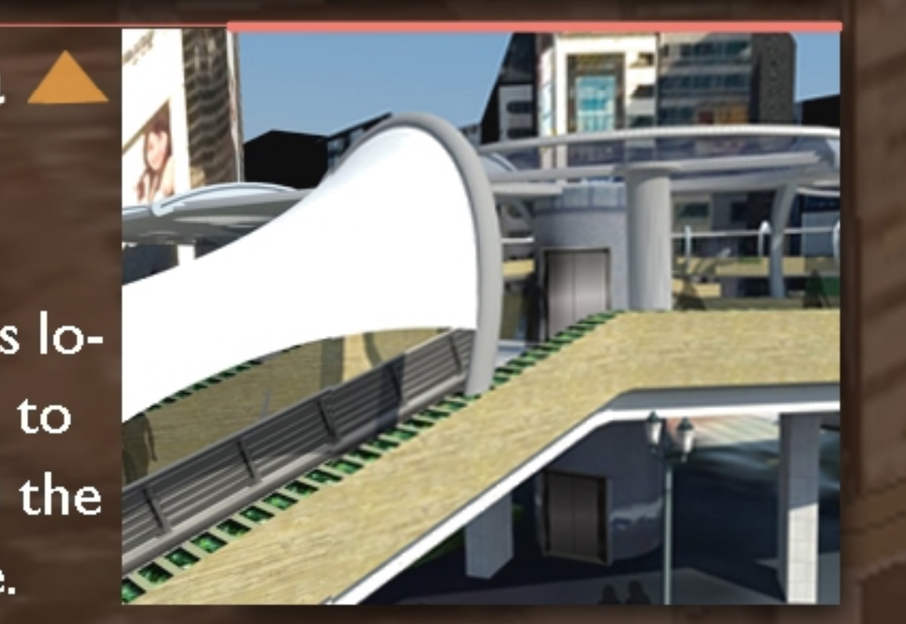
- 3 balconies set up on the bridge are especially designed without seats in order to let the pedestrians not to stay for long, or they could choose to rest on the green bench seats. The balconies have several functions: 1. waiting & gathering; 2. Relieve the pedestrian flow pressure of other areas; 3 Sightseeing.

Balcony outside view

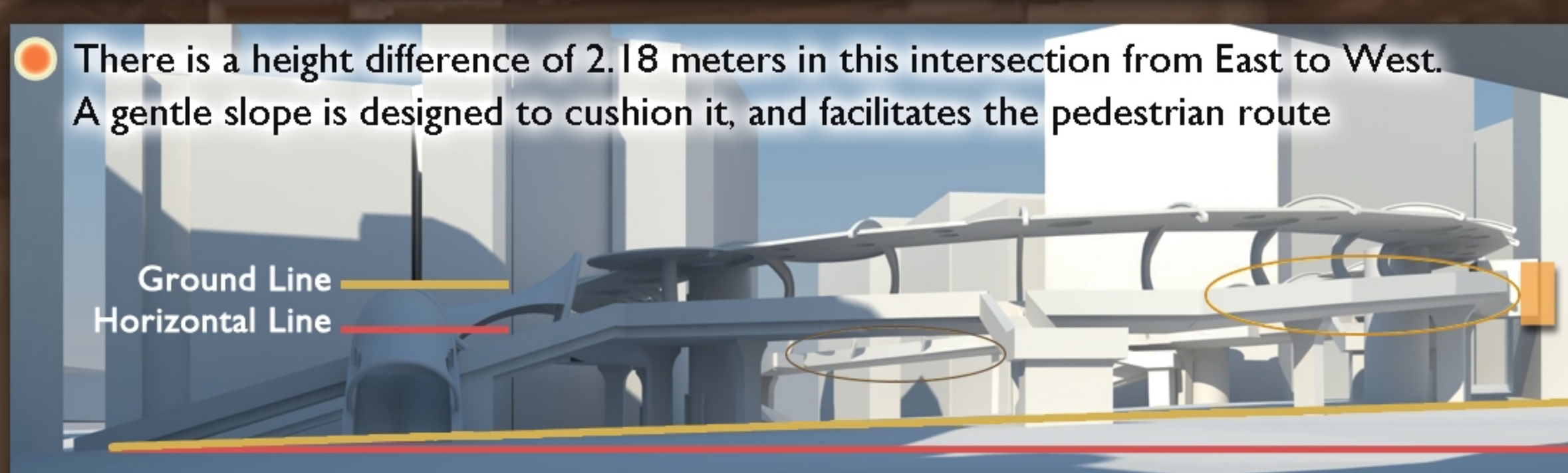
Balcony inside view

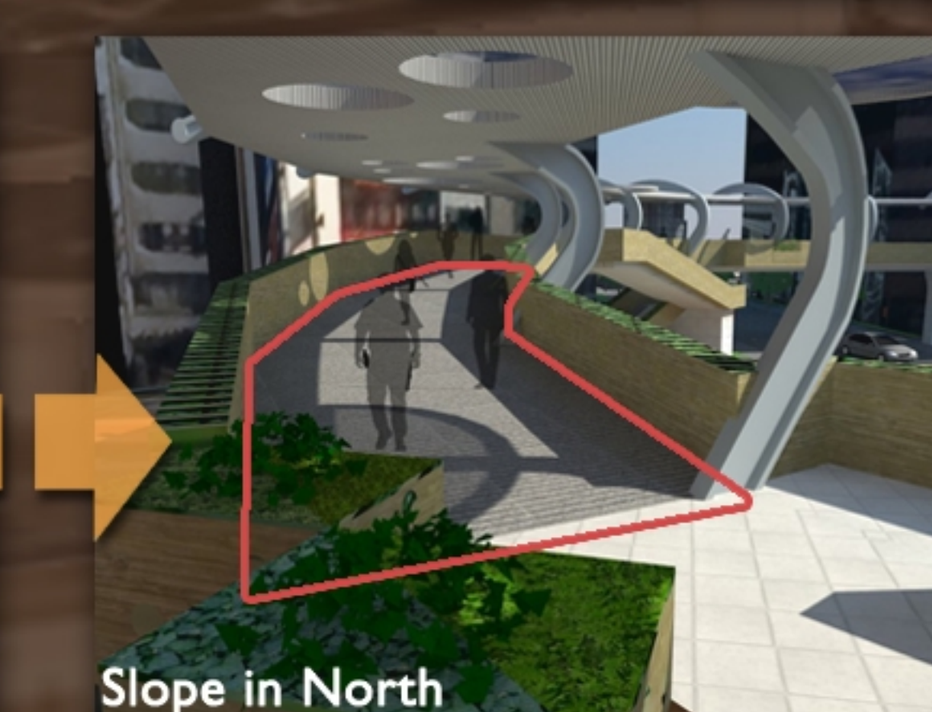
Functional Area

- 4 individual elevators locates in 4 directions to facilitate the old and the inconvenient people.



- There is a height difference of 2.18 meters in this intersection from East to West. A gentle slope is designed to cushion it, and facilitates the pedestrian route

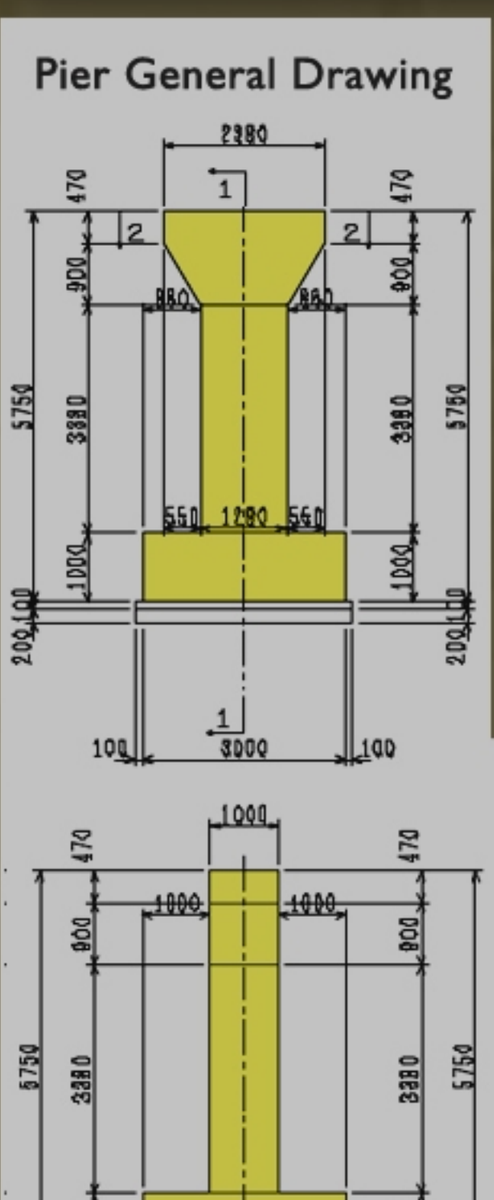




Slope in North

Seismic Design & Simulation

Pier General Drawing



The piers is designed in UC-1 Series• Pier Design(data files submitted), then import to Allplan to check up if any distributed steel errs. After fixing the distributed steel (data files submitted), the corresponding structure of the bridge body was imported in UC-frame 3D for the earthquake simulation, whose data was the Great Hanshin Earthquake in 1995. The Simulation result is shown at lower right corner, with 4 components only slightly damaged and 4 microcracks.

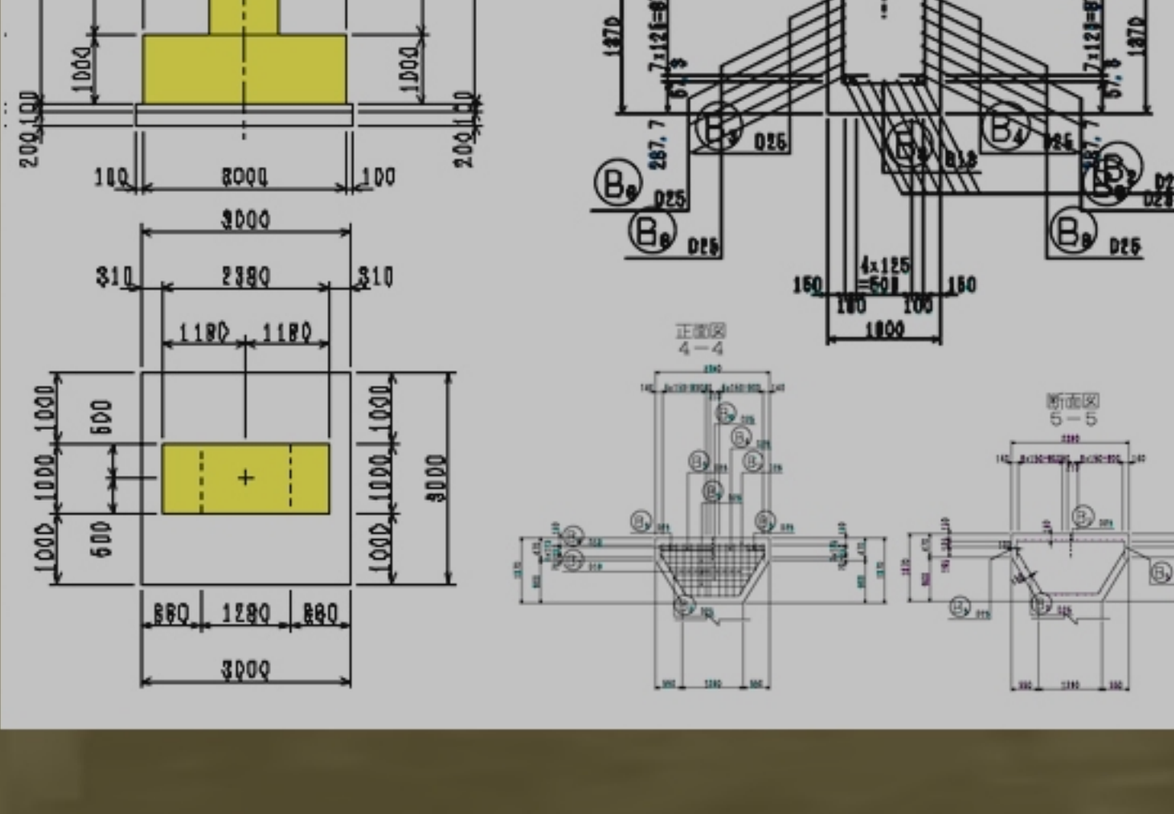
Steel Bar Table 1/4

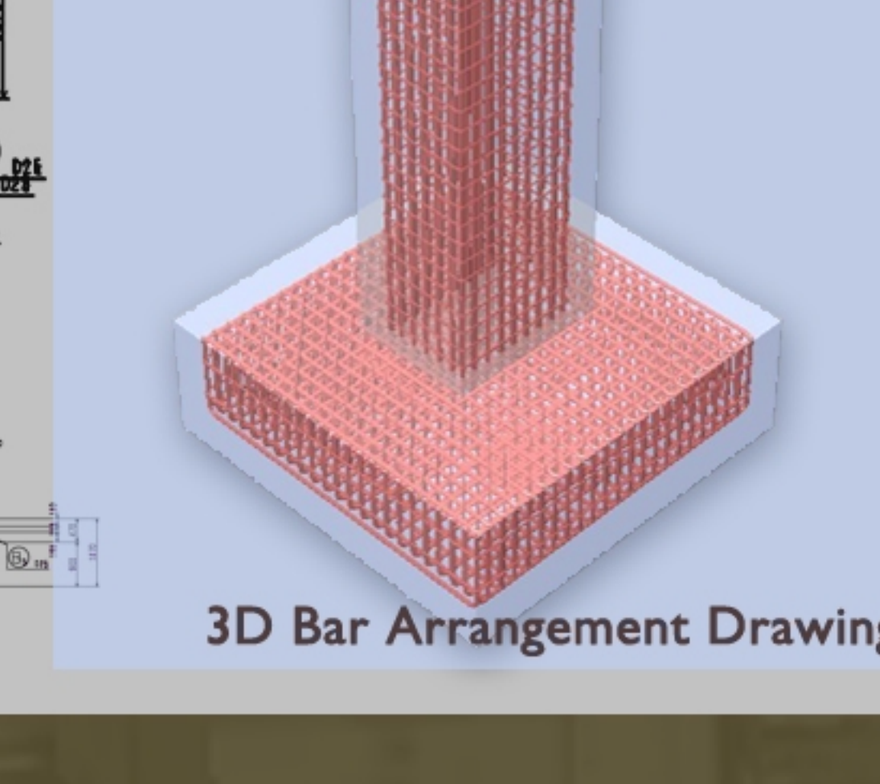
記号	径	長さ (mm)	本数	単位質量 (kg/m)	1本当り質量 (kg)	質量 (kg)	摘要
B1	D25	2930	7	3.98	11.661	82	
B2	D25	3580	7	3.98	14.192	99	
B3	D25	1000	2	3.98	4.898	9	
B4	D25	2010	2	3.98	6.918	17	
B5	D25	1400	2	3.98	5.570	12	
B6	D25	1740	12	3.98	6.925	83	XXXX
B7	D13	3360	9	0.995	3.343	30	
B8	D13	1080	30	0.995	1.075	32	
B9	D13	2200	8	0.995	2.219	18	XXXX
B10	D13	520	4	0.995	0.517	2	
B11	D13	520	4	0.995	0.517	2	
				D25		302 kg	
				D13		79 kg	
				合計		381 kg	

Total

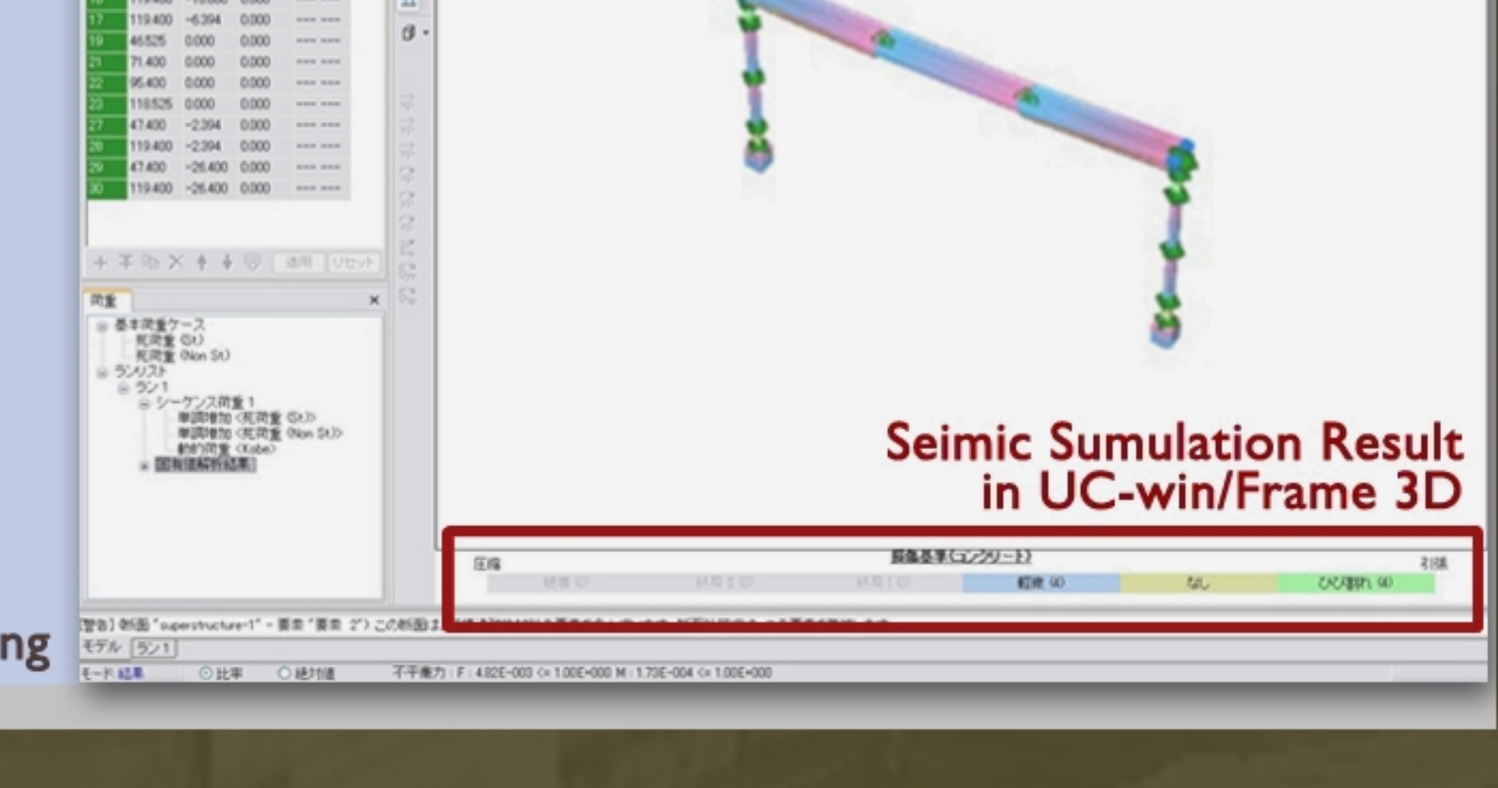
D41	1711 kg
D35	2888 kg
D25	302 kg
D16	1813 kg
D13	79 kg
合計	6893 kg

Bar Arrangement Drawing 1/8





3D Bar Arrangement Drawing

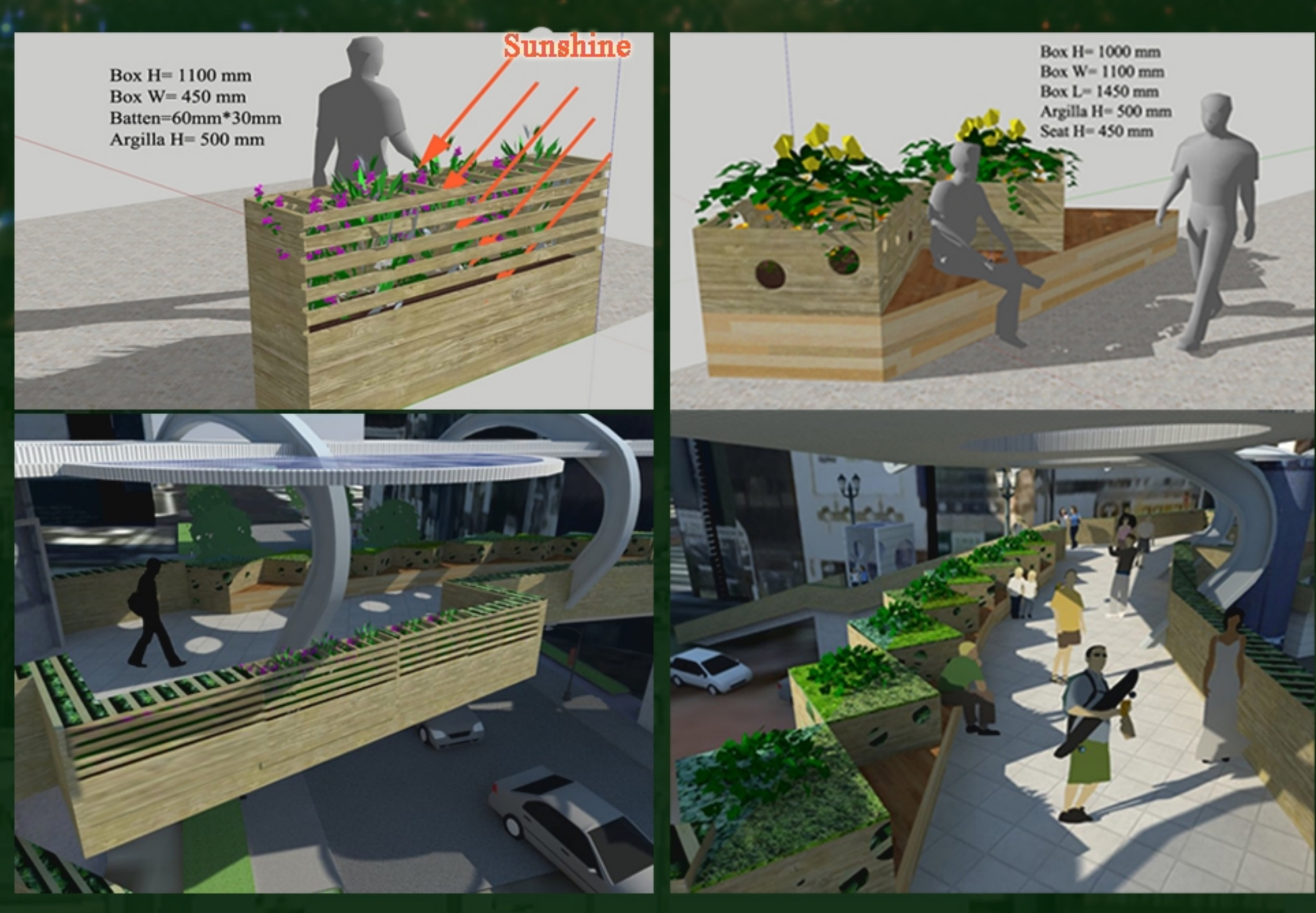


Seimic Sumulation Result in UC-win/Frame 3D

Eco-design

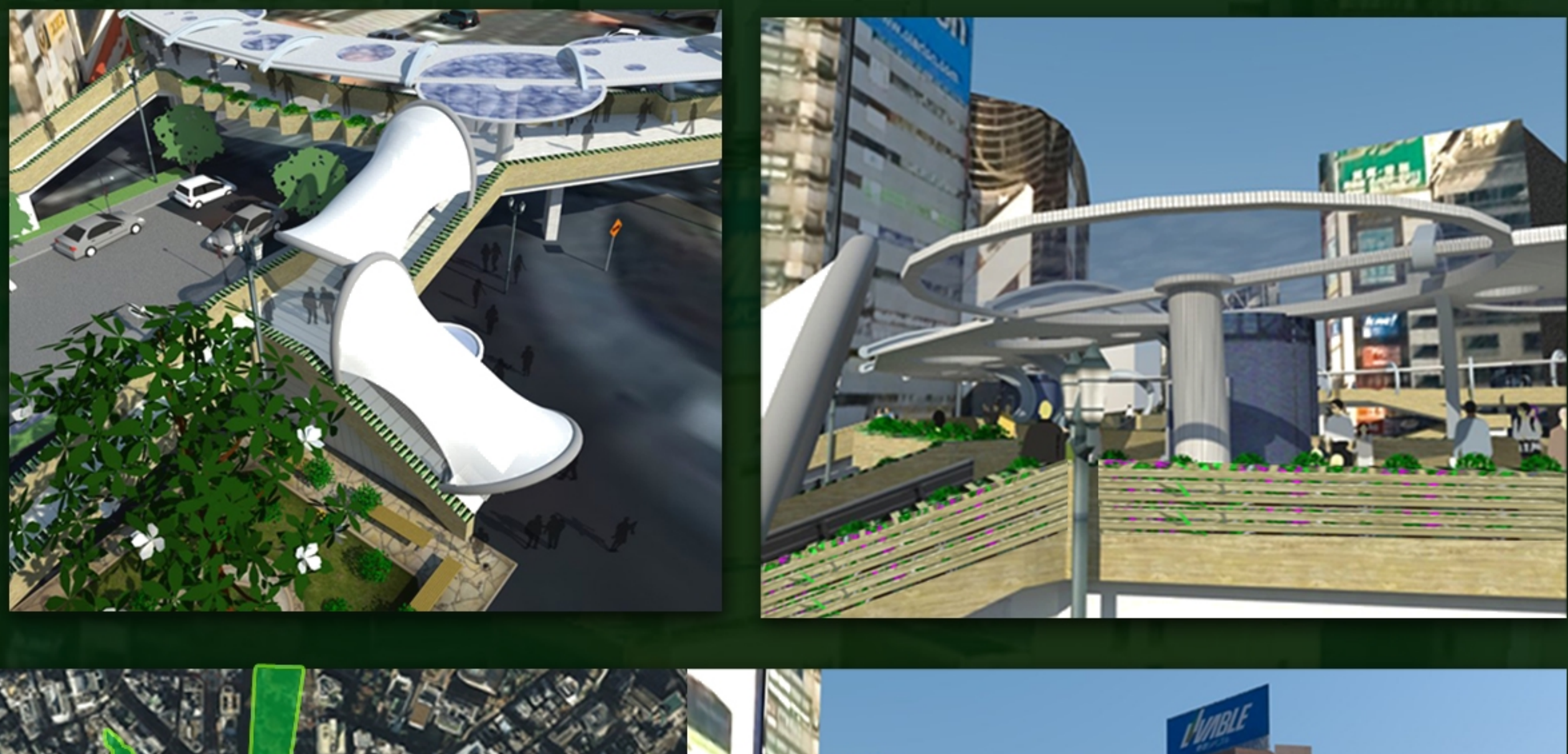
Wooden Parapet & Green Bench Seat

- Low carbon and ecological materials are widely used to make people feel closed to nature. Wooden grids which appears an outer green wall could increase the permeability to sunshine, also increase the stability of rattan plants. The wood materials in use is isolated between the deck and the roof of the bridge in case of fire.
- Comfortable seats are provided just next to the parapet. The scale of seat and parapet listed on the right strictly complies with ergonomics.
- Three kinds of behaviour patterns as walk, short-time stay, long-time rest are coordinated on this passenger foot-bridge.



Tensioned Membrane

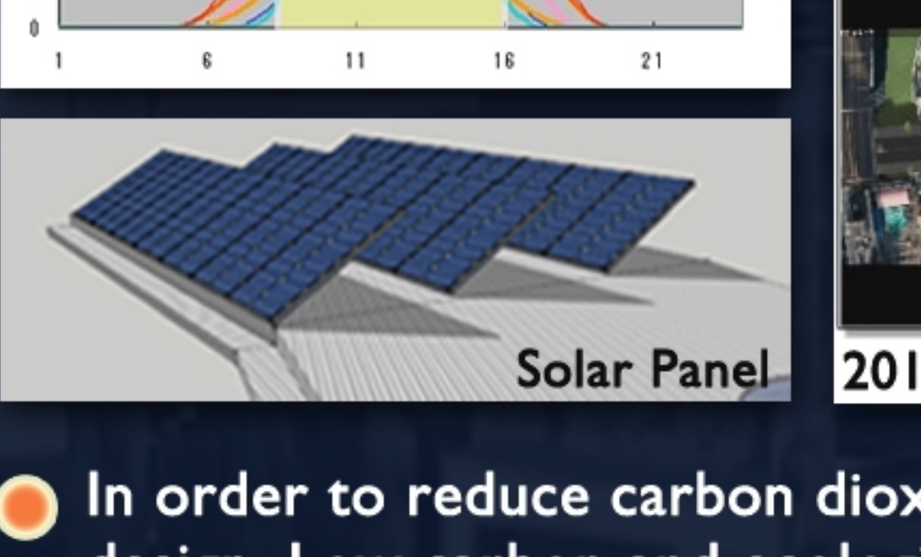
- ETFE (Ethylene-tetrafluoroethylene), a lightweight new materials with effective thermal properties and transmission of light, is used as the outer roof of the birdge. ETFE can adjust the closed or half-closed environment with winter heat preservation and summer heat dissipation.
- ETFE has the features of high resistance to stain and fire. Usually the membrane can eliminate the main dirt with rainfall, which almost needn't daily maintenance.
- The characteristics of lightweight and fire resistance make it a considerable advantage even in the situation of earthquake in Shibuya.

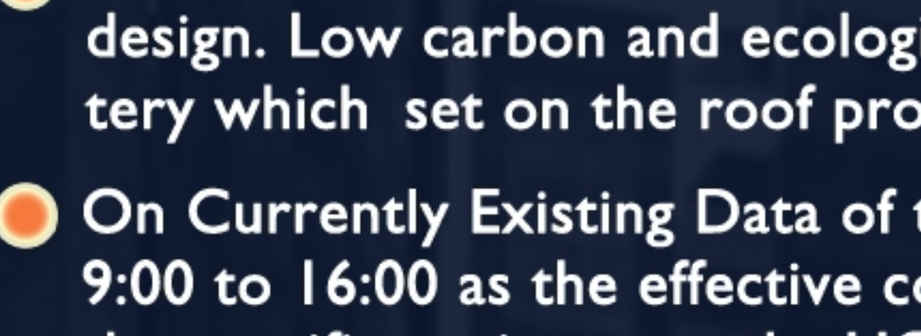


Environmental Design

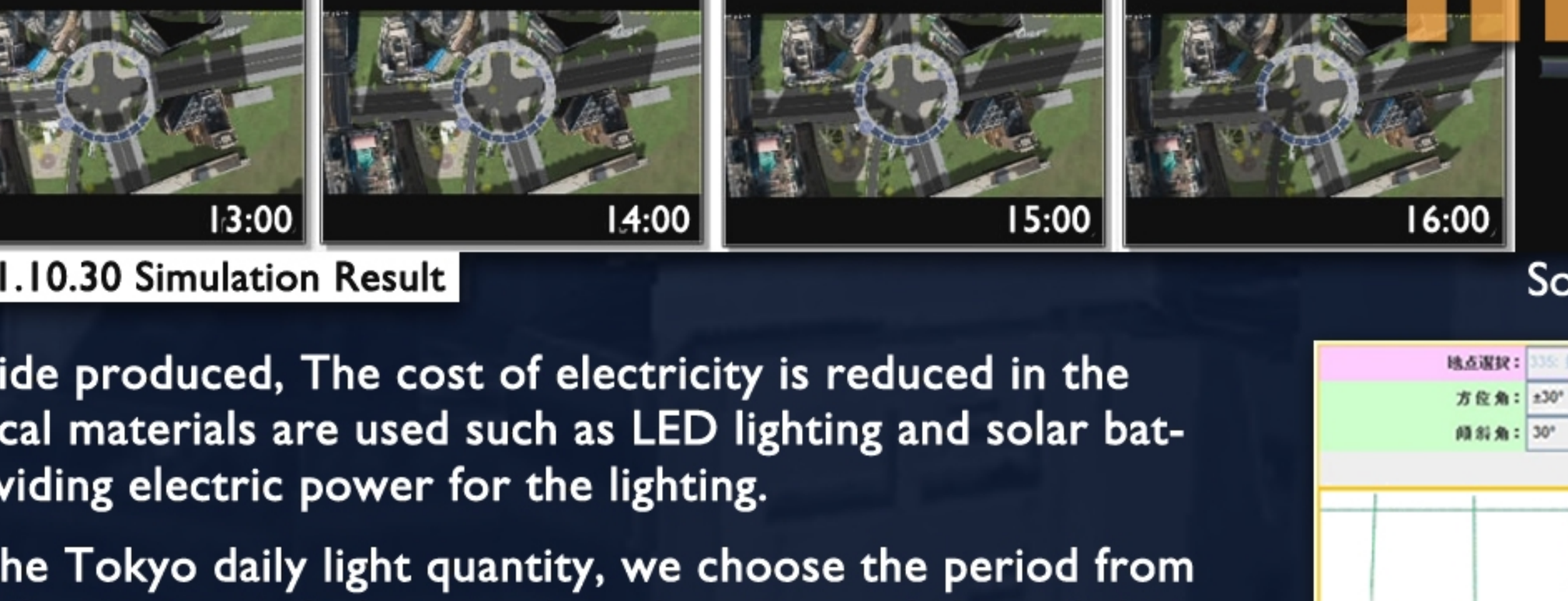
- Shibuya, especially the JR Station, is lack of green area as the aerial view shows(right). Surrounded by intensive commercial buildings, this place calls for more fresh air and leisure space. The OASIS could be an essential acupuncture needle healing this area.
- Side road trees are set to absorb carbon dioxide and ease the visual pressure of tall buildings. More plants are provided in this scheme.
- A garden is created here to make people passing by pleasurable and staying comfortable, increasing the intimity to natural environment and flexible use of public space.

Solar Power Illumination Simulation

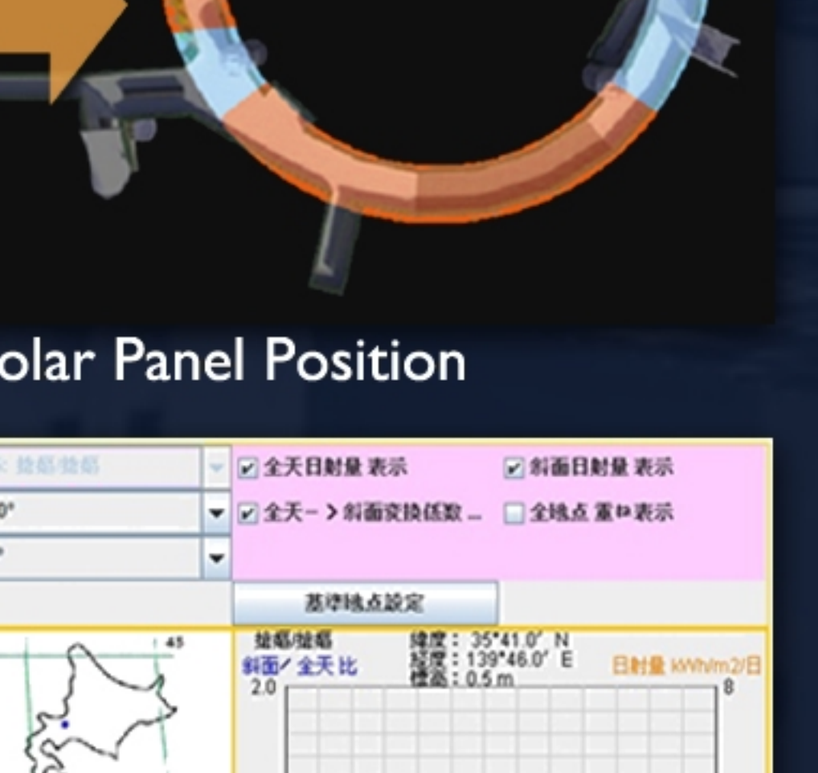




Solar Panel

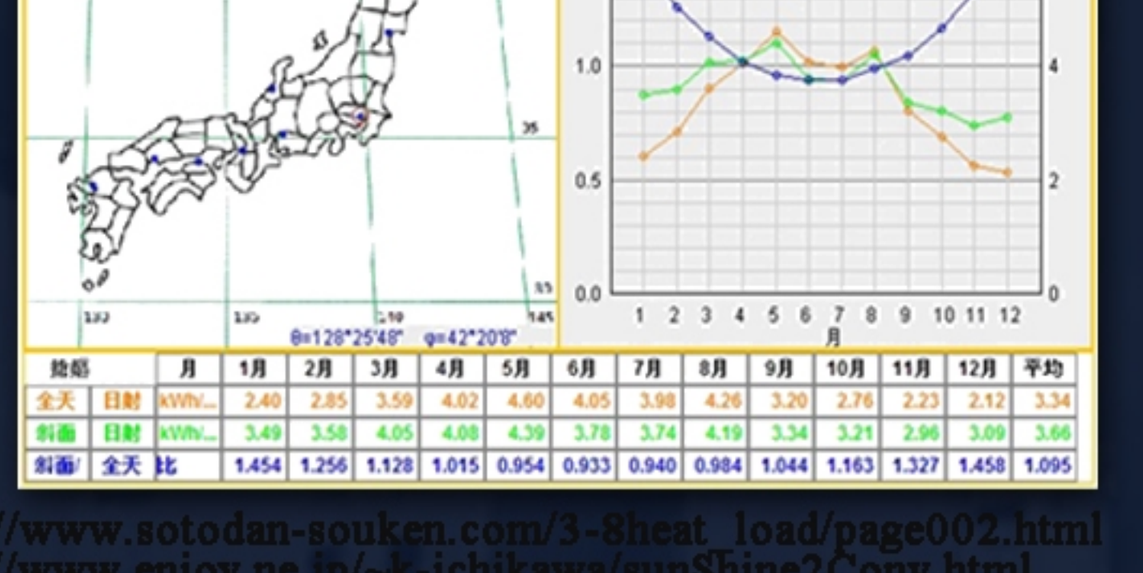


2011.10.30 Simulation Result



Solar Panel Position

- In order to reduce carbon dioxide produced, The cost of electricity is reduced in the design. Low carbon and ecological materials are used such as LED lighting and solar battery which set on the roof providing electric power for the lighting.
- On Currently Existing Data of the Tokyo daily light quantity, we choose the period from 9:00 to 16:00 as the effective collection period, then simulate the average daily sunlight in the specific environment by UC-Win/Road. The space where could receive most sunlight averagely on the roof might be used for solar power generation by Solar battery panels.
- The Predicted Power Output (date kWh /) = The amount of solar radiation (kWh/m2/day) x (slope/total ignition) x LCD capacity (kW) x (1 - Temperature loss) x (1 - Power Conditioner loss) x (1 - Other losses)
Losses of Temperature:
in spring (March to May): 15%   in summer (June-August): 20%
in autumn (September-November): 15 %   in winter (December to February): 10%
Pawakon (power conditioner) Loss: typically about 5-6%   Other losses: typically about 5-7%



Reference:http://www.sotodan-souken.com/3-8heat_load/page002.html
http://www.enjoy.ne.jp/~k-ichikawa/sunShine2Conv.html