3D Modeling of the Earthquake Recovery Plans of Otsuchi-cho, Iwate

Supporting Disaster Area with Autodesk Infrastructure Modeler

The Town of Otsuchi-cho, Iwate was destructively damaged by the tsunami of the Great East Japan Earthquake. The town officials formulated the Earthquake Recovery Master Plans at the end of 2011, taking in a request of the local residents who seriously suffered. They are collaborating with construction consultants to detail the plans for execution which include raising the level of residential area, developing relocation area in heights, building of road and evacuation routes, and arrangement of public facility, commerce-and-industry area, etc. Engineers from The Iwate Digital Engineer Training Center (Iwate DE, hereafter) are building 3D models of the recovery plans using "Autodesk Infrastructure Modeler" to express it visually. The 3D models would help local residents to understand the plans and facilitate agreement formation.

Town Re-Building from “Zero”

"Make a evacuation route between central town center and heights", "Allocate commercial area around here- " --- officials of revival office at Otsuchi-cho, Iwate, looked into the screen of a notebook PC and directed to engineers of Iwate DE to make the 3D image of the town after revival. The cental area of Otsuchi-cho was almost totally destroyed by the tsunami of the Great East Japan Earthquake on March 11, 2011.

Study of the recovery plans by 3D model at Otsuchi-cho’s town hall (left). 3D model under construction (right)

Mr. Kenji Sakakibara , chief lecturer of the Iwate DE which located in Kitakami-city, Iwate, built

3D images of each part of the town after recovery by "Autodesk Autodesk Infrastructure Modeler" (Infrastructure Modeler, Hereafter) , and brought them to the town hall of Otsuchi-cho in his notebook PC. They examined details of the plans and discussed about undecided parts seeing the computer graphics (CG) from various angles.

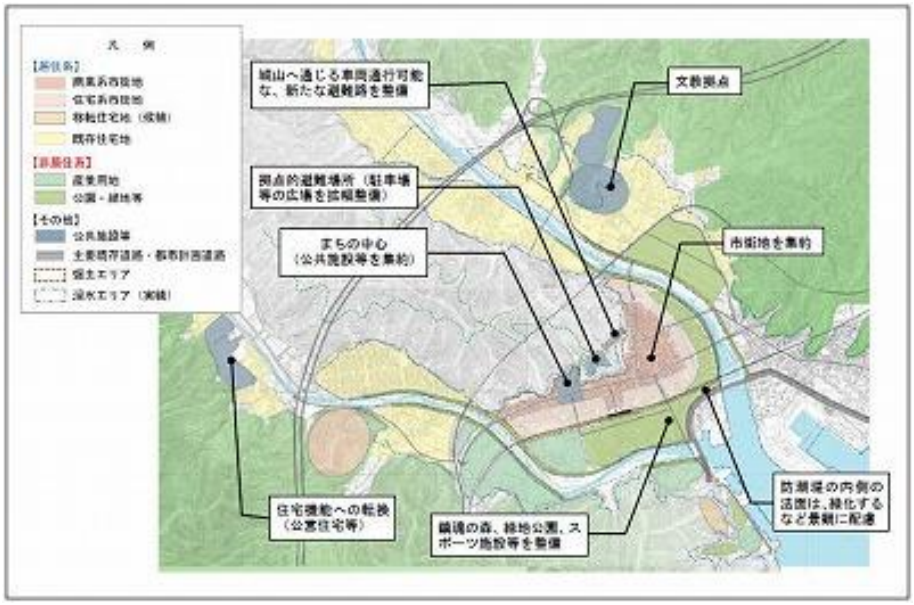
Otsuchi-cho is located in Sanriku Coast where "Otsuchi River" and "Kozuchi River" flow into the Pacific Ocean. The flat ground beside the ocean used to be crowded with buildings, such as a residence and a public office. After the tsunami attacked the area, more than 3700 houses were completely or half destroyed, 800 people or more dead, and 400 or more people were missing.
The mayor and the senior officials of the town also fell victim to tsunami, the town temporarily lapsed into malfunction. Then Mr. Yutaka Ikarigawa, new mayor who has strong interest in usage of information and communication technology, young officials began towards revival of the town with support of temporal officials from a country and Iwate prefecture.
Now, a former town center only leaves the foundation of a building. The steep mountains surround it. They are going to build a new town at this place from "Zero" which consists of the tide embankment which prevents the damage of tsunami, a central town area, roads, and new residential area.

Steep mountains surround destroyed town center by the tsunami

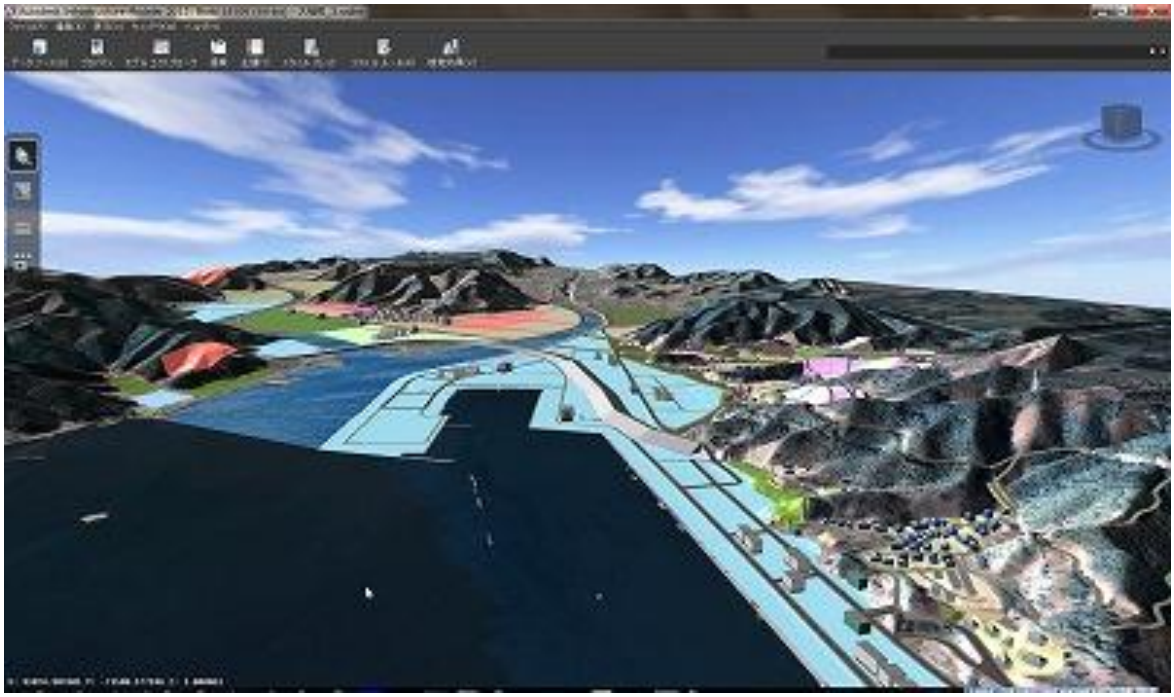
3D Model Clarified Inconsistency of the Plan

Town center, public facility, residential area, embankments, tsunami refuge buildings etc. were planed according to "Guidelines of Revival Planning" appointed for every area. Then construction consultants who were trusted by Japanese government made maps of the plans of 1/3000 to 1/10,000 scales at the end of 2011.

Iwate DE, which is a training organization for 3D CAD operators of manufacturing industry such as automobile and machinery, wanted to support disaster area with 3D technology. Development and Promotion Bureau of Southern Iwate Prefecture introduced Iwate DE to Otsuchi-cho, and Iwate DE summarized images of recovery plans in each part of the town in a 3D model.



The revival image of Machikata district of the Otsuchi-cho expressed on the map



Engineer of Iwate DE made 3D model of the same district as above

Vertical interval and steepness of slope were especially intelligible on 3D model.
When they examined the proposed residential site developed in heights by the 3D model, they found problems of the slope which was not noticed on the maps.
"If we cut mountain in a plane, the remained slope would be too steep and dangerous. Therefore, it would be better to cut like stairs. As it is unsunny if the land faces to the north, let's turn it to the south." Mr. Koya Okuni, Chief Officer of the Revival Promotion Office of Otsuchi-cho, proposed.

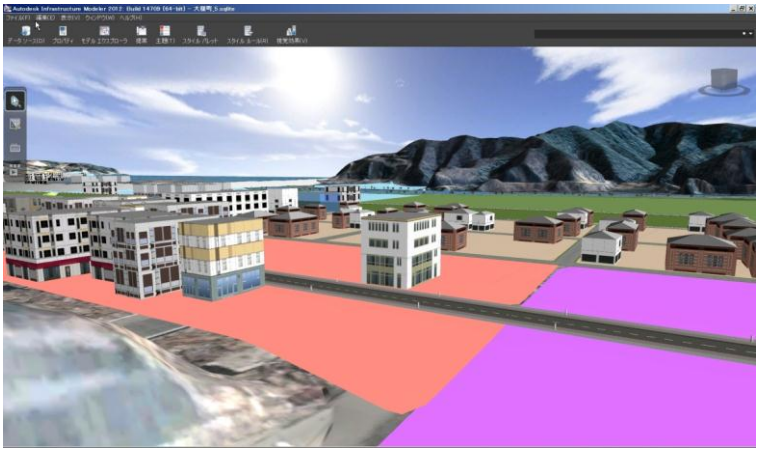
The revival images of each district were checked comparing drawings and 3D model

Beside Mr. Okuni, Mr. Ayato Matsuhashi of the office checked the plans together. He says, "When I see planned roads by 3D, I could find visually such places as slope is too steep, or cut and fill is too large to construct them actually.

By seeing a recovery plans by 3D, the problems of the plans, even which construction consultants did not notice, were often found.

In this way, the work progressed steadily, checking visually the points in question which were not known on maps or drawings.

A town area of Otsuchi



Scenery of the town after landfill of 3.5m height seen by 3D model

Scenery from height of Ando district by 3D model

What is Infrastructure Modeler?

"Autodesk Infrastructure Modeler 2012" used for 3D modeling of the recovery plans was put on the market from Autodesk in November, 2011. The main feature is that it can read various data formats and unify to a single 3D model.

"Autodesk Infrastructure Modeler 2012" currently used for 3D-ization of a recovery program was put on the market from Autodesk in November, 2011.

The feature is reading the data of various forms and being able to unify to one 3D model.

It reads 2D CAD data, GIS (Geographic Information systems), and raster images such as satellite photographs, and makes a 3D model of existing infrastructures which includes geographical feature and natural environment.

Then it imports structure models, such as detailed geographical feature, cut and fill, tide embankments, railroads and roads, designed by AutoCAD Civil 3D, AutoCAD Map 3D, etc., and revival plans can be summarized on one 3D model.

Persons other than civil engineers or architects can also understand proposed recovery plans easily by "3D walk-through", seeing alternatives from various viewpoints or angles.

Mr. Sakakibara says, "Infrastructure Modeler has flexibility to make a 3D model with rough information for the time being, and gradually embody it with advance of the plan."

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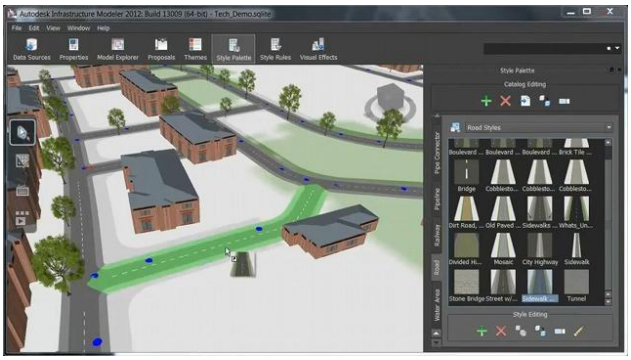
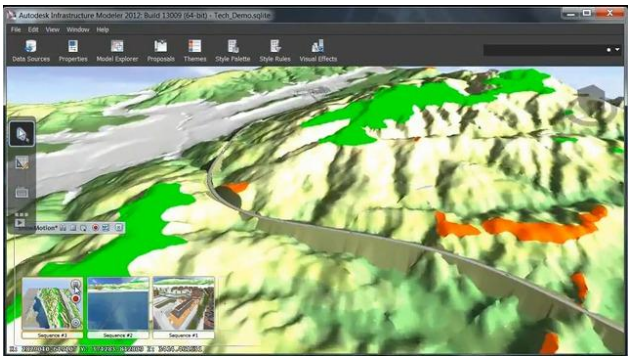
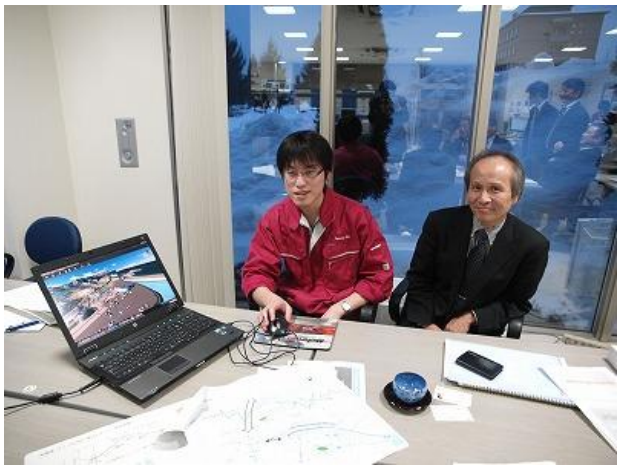




Using Infrastructure Modeler, roads can be modeled by drag and drop from the menu (left).Example of 3D model made by importing cuts and fills designed by AutoCAD Civil 3D on a digital terrain map.(right)

Although Mr. Sakakibara of the Iwate DE was a master of CAD/CAM (design and manufacture by computer) system for manufacturing industries, civil engineering and infrastructure fields were entire outside domains.

Mr. Sakakibara mastered Infrastructure Modeler by self-education, and took a 2 day instruction course of AutoCAD Civil 3D to perform modeling, such as tide embankments, cuts and fills, roads. He is supporting 3D modeling of the recovery plans, studying technical terms of civil engineering and architecture.



Mr. Sachio Kurose, president of Iwate DE (right side in left photograph) and a chief lecturer, Mr. Kenji Sakakibara (left side in left photograph). The office of Iwate DE is equipped with 3D printer, 3D plotter, 3D scanner, etc. (right photograph)

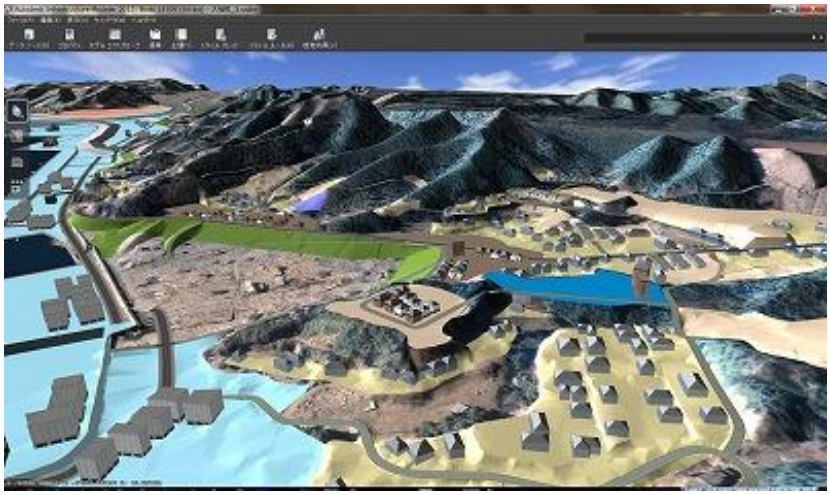
3D Model Highly Evaluated by Mayor and Officials, Going to be used for Local Briefing

It is very new to use 3D model for examination of the recovery plans of the Great East Japan Earthquake.

Mr. Sachio Kurose, president of Iwate DE, and Mr. Sakakibara performed the presentation for the sample 3D model of the recovery plans in front of Mr. Ikarigawa, the Mayor of Otsuchi-cho, or the personnel on January 16.

They explained their support which can be realized by 3D model such as concept check of the recovery plans on present geographical condition, comparison and examination of various project plans, information sharing, a flexible examination, etc.

The figure of tide embankments and land-filled town center seen from the sky or the ground level were projected on the screen with reality.



3D image of residential area developed in height

3D image of sea shore, pine grove and tsunami refuge buildings

Mayor Ikarikawa looked at the 3D model and said, "The contents of the recovery plans were very intelligible", and he made public the plan which utilizes 3D model by the recovery planning.

The presentation of the day was reported by local television and newspaper. Inquiries are coming from other disaster areas and construction firms to Iwate DE.

The “Otsuchi-cho’s East Japan Great Earthquake and Tsunami Recovery Program” is planned to be carried out for 8 years, divided into retrofit stage (till the 2013 fiscal year) , renaissance stage (2017-2018), and progressive stage (2017-2018).

The project execution plan is summarized during the 2011 fiscal year, and it will go forward towards revival.

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