

**S05: JAEE Special Session S05-01**: Spectacular Projects of **Base-Isolated Buildings** 

# **SEISMIC ISOLATION RETROFIT** FOR MAJOR TALL BUILDING

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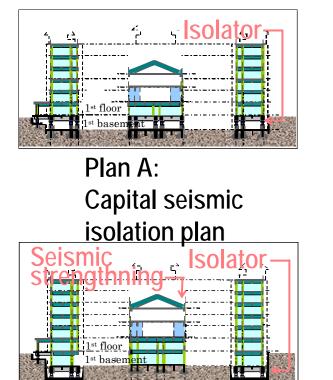


### **INTRODUCTION**

- Seismic isolation retrofit for the large-scale cultural assets building built 70 years ago.
- Selection of the most suitable method of seismic retrofit work method by objective evaluation from 5 plans. (FIG.1)
- Consideration to the simulated earthquake motion expected to occur in a giant earthquake based on the latest knowledge.

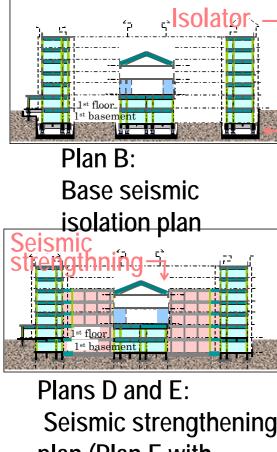
#### 2. SELECTION OF SEISMIC RETROFIT WORK METHOD

we selected seismic retrofit as the optimum work method in consequence of scrutiny of the main building's characteristics and careful and objective comparisons and examination of methods in cooperation with academic experts.



Plan C: Partial seismic isolation plan

Fig.1 Conceptual diagram of each plan



Seismic strengthening plan (Plan E with expanded floors)

		Seismic isolation work mathod			
		Plan A: Capital seismic isolation plan	Evaluation Score x Weight	Plan B: Base seismic isolation plan	Evaluation Score x Weight
Seisnie performance	Required seismic performance Structure: Class I Nonstructural member: Class A Construction equipment: Class A	The floors above the ground can obtain high somme performance by a seincric isolation installed on the top of each column on the first basement. However, these seismic isolators may not properly maintain their function due to unexpected behavior of the building in case of an exchange building the first basement where the mismic isolators are installed is of a seismic isolation structure.	O 21	Since seimic isolators are installed on the bottom of the foundation, the earthquake acceleration of all floors, including the basement, can be reduced. All of the floors, including the basement, can obtain high seimic performance.	© 30
	Necessity of strengthening, including ceiling finish	Unnecessary in principle because earthquake acceleration can be reduced.		Unnecessary in principle because earthquake acceleration can be reduced.	
	Necessity of measures to prevent bookcases, etc. from tumbling	Measures are required for tall racks and bookcases, etc. installed on the floor of the first basement to prevent them from turnbling.		Measures are required for tall racks, etc. to prevent them from tumbling.	
Effacts on operations during estimate network work	Feasibility of work with the machine room and the printing office remaining on the first basement	Infeasible. Relocation and substitute facilities are required.	07	Feasible. Although part of the work must be carried out indoors, substitute facilities are not required.	© 10
	Feasibility of work with each room remaining on the first basement	Infeasible. Relocation and substitute facilities are required.		Infessible. Substitute facilities are required because indoor work must be carried out.	
	Feasibility of work with facilities remaining on the floors above the ground	Infeasible in part. Some facilities must be relocated or substitute facilities are required depending on noise or vibration.		Feasible.	
	Noise, vibration, availability of passages, etc.	<ul> <li>The first basement will be seriously affected by vibration or noise.</li> <li>The passages to the West Annex and the Aichi Prefoctural Assembly will be temporarily closed.</li> </ul>		The first basement will be affected by vibration or noise.     The passages to the West Annex and the Aichi Prefectural Assembly will be temporarily closed.	
	Scale of temporary work and work excavation, installation of retaining walls	<ul> <li>A wide area, including the courtyard, is covered by the work.</li> <li>Part of the periphery of the building (locations of dry areas) must be excavated.</li> <li>New retaining walls must be installed in part of the puriphery of the building.</li> </ul>		<ul> <li>A wole area, including the courtyard, is covered by the work.</li> <li>The building in the courtyard must be relocated.</li> <li>The entire area surrounding the building must be excavated.</li> <li>Retaining walls will be installed all around the building.</li> </ul>	
Effects on operations after names retrofit work	Availability as in the past or application of rooms	The space around the reinforced columns on the first basement becomen survow.     Part of the printing office on the first basement must be relocated.     Almost all facilities relating to office work are available.	0 14	The entire building is available as in the past.	© 20
	Availability of each entrance and passage to the main building	All entrances and passages are available.		All entrances and passages are available.	
	Availability of corridor to the Aichi Prefectural Assembly	A passage will be available by reconstruction.		A passage will be available by reconstruction.	
	Availability of underground passage to the West Annex	A passage is available.		Although a passage is available, large-scale EXPJ is required halfway.	
	Effects on equipment wiring and piping	Part of the wiring and piping must be rerouted because of the reinforcement of the columns on the first basement.     Join flexible piping with joints on the first basement.		Join flexible riping with joints under the foundation (on the floor where seismic isolators are installed).	
	Usage of courtyard	Unchanged from the current situation.		The courtyard will become narrower than the current area because dry areas will be set around the building.	
	Situation of EXPJ, etc.	<ul> <li>An elevator and a staircase to the first basement must be additionally installed.</li> <li>EXPT will be installed between the main building and the West Annex and the Aichi Prefectural Assembly.</li> </ul>		<ul> <li>EXPJ will be installed between the main building and the West Annex and the Aichi Prefectural Assembly.</li> </ul>	
Effects on registered cultural asset	Changes to the exterior of the building Degree of effects on the registered cultural asset	The shape of the columns on the first basement will change.     The appearance of the courtyard will be affected.     A notification of changes to registered cultural assets is not necessary.	∆ 5	There is little effect on the appearance of the building.     A notification of changes to register	<b>0</b> 10
Term of work		About 40 months	© 10	About 45 months	07
Total project cost (including relocation and temporary work expenses)		S to 9 billion yen	× 0	6 to 7 billion yen	△ 10
Overall evaluation		A	57	0	87

3.

## Takao Nishizawa

#### SIMULATION EARTHQUAKE **MOTION BASED ON THE** LATEST KNOWLEGE

The designer, and academic experts agreed to jointly create simulated earthquake motions of this district for design at the owner's expense, as the academic experts proposed.

The resultant simulated earthquake motions "Sannnomaru Waveforms" were, as expected, earthquake motions with relatively large amplified long-period components. (FIG.2) 4. OUTLINE OF SEISMIC ISOLATIO

# **RETROFIT DESIGN**

Three features: 1) consideration is given to long-period earthquake motions expected to occur in a giant earthquake; 2) column-tocolumn intervals are small, up to four columns are collectively supported by a single seismic isolation member as a seismic design approach to the cultural asset with many columns for the purpose of a long-period structure, and cost reduction is achievable by reducing seismic isolation members; (FIG.3) and 3) the  $\square$ shaped plane building is designed to exhibit behavior as a seismically isolated, integral building.

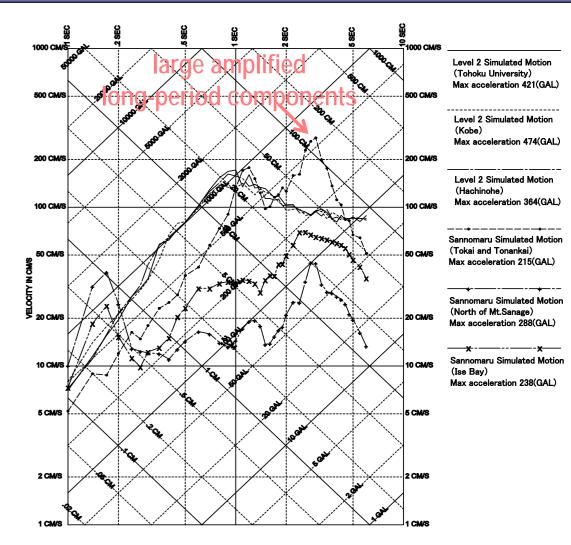


Fig.2 Response spectra of input earthquake motions adopted

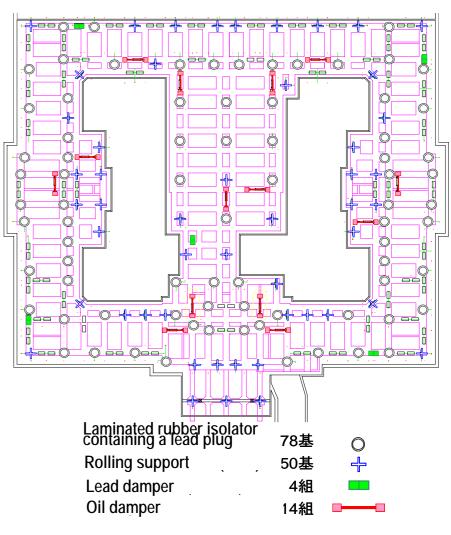


Fig.3 Layout of seismic isolation members