# Eearthquake-Resistant Building Technology

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# Today's Topics

Resilience = Robustness + Recovery

Earthquake-Resistant Structure (HARD)

Earthquake Resilient Mechanism (SOFT)

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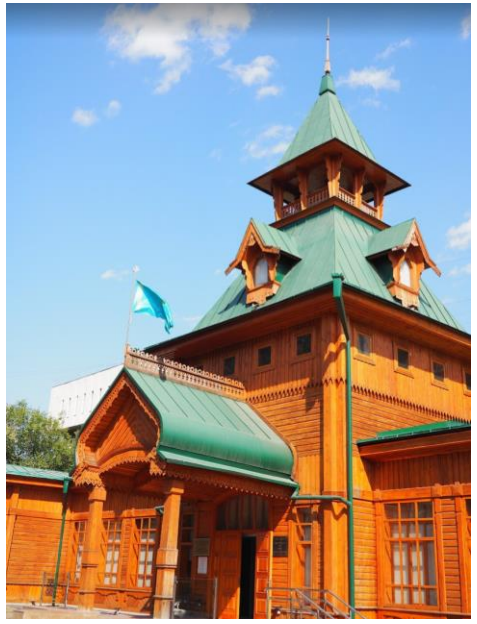

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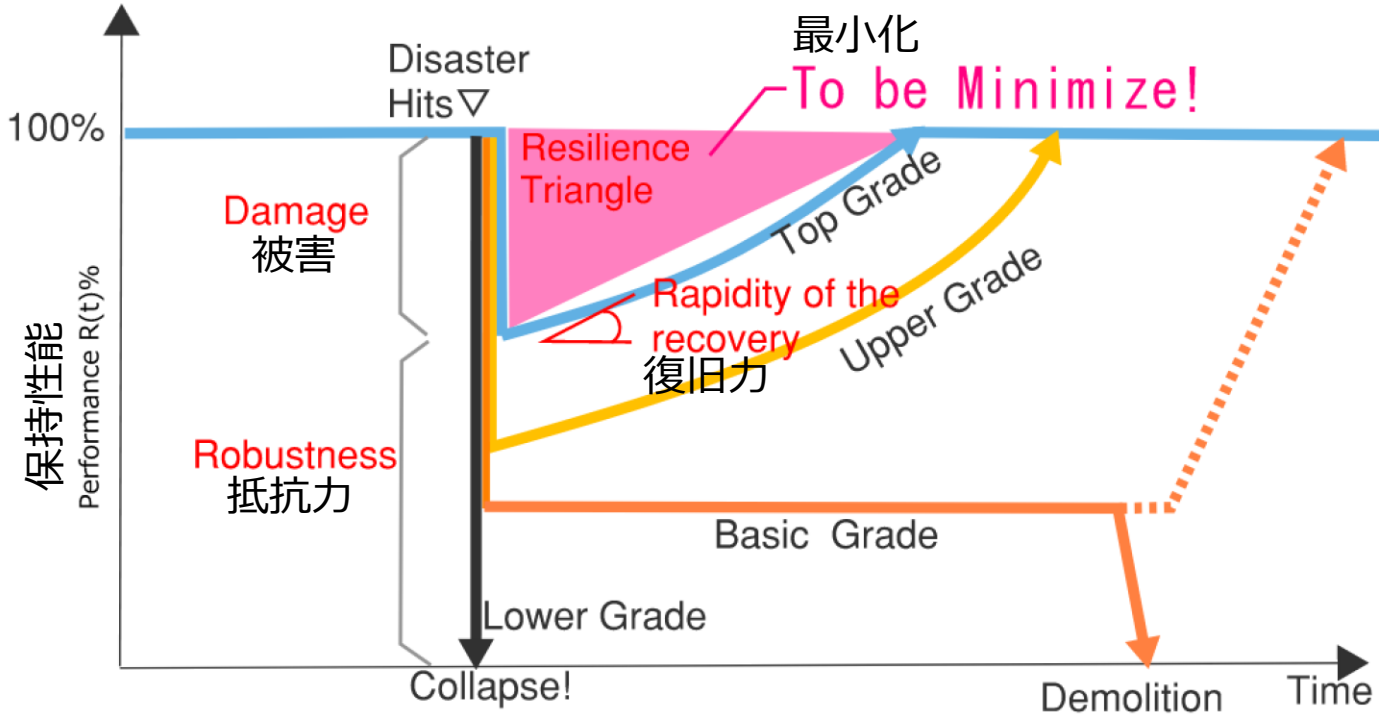
# What is Resilience?

## Resilience = Robustness + Rapidity of the Recovery




Schematic of Resilience

建物のレジリエンス性能指標などの概念（2020　建築学会の図に加筆）
Schematic of Building Resilience Performance Indicators and Other Indicators (2020 Additions to the diagram by the Architectural Institute of Japan)

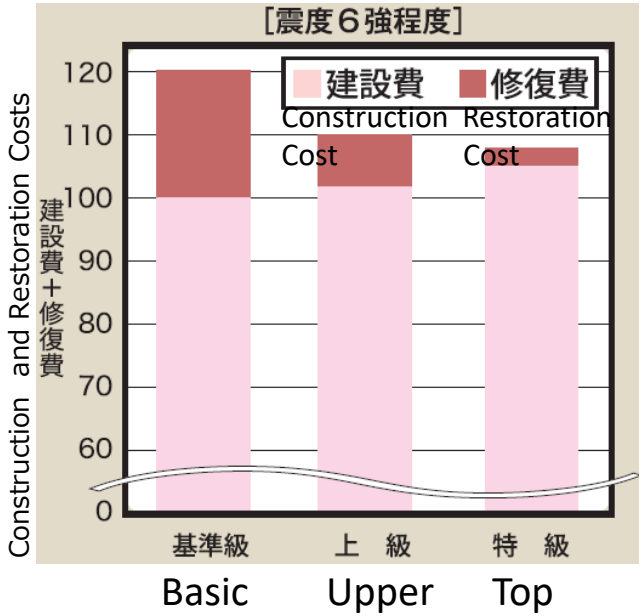



Diagram of construction and restoration costs

JSCA性能設計[耐震性能編] より
The Guide to Safe Buildings JSCA Performance-based Seismic Design

# Earthquake-Resistant Design : Seismic Isolated Str. and Vibration Control Str.

## （HARD）

## Tokyo Skytree

(Vibration Control Structure)

Tallest building in Japan

(JSCA Award)

## Nagoya Mode Gakuen

(Vibration Control Structure)

Skyscraper with special shape

(JSCA Award)

日建設計「日建設計の制振・免震建築」パンフレットより

## Japanese Red Cross Ishinomaki Hospital

(Seismic Isolated Structure)

Maintained its function as a regional base hospital for disaster relief after the Great East Japan Earthquake without suffering any damage from the earthquake or tsunami

(JSSI Award)

# Earthquake Resilient System (SOFT)

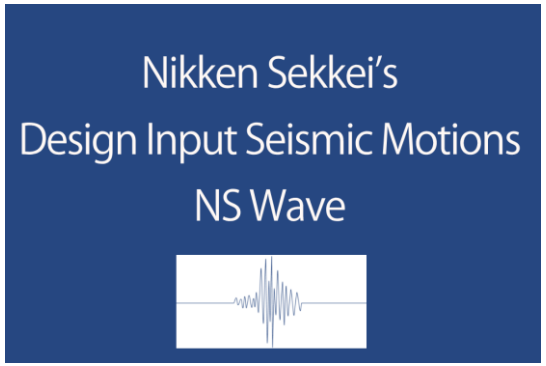
## Increasing earthquake resilience from the SOFT aspect

1_Assuming ・・・**NS Wave®** Artificial earthquake waves considering faults and ground

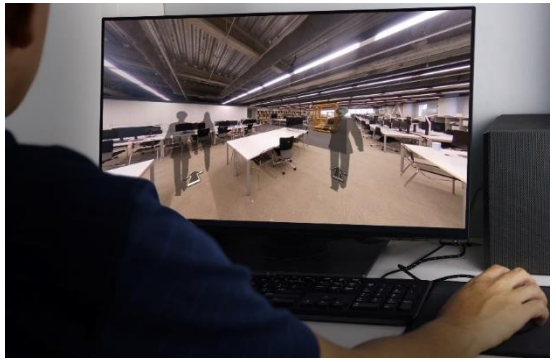
2_Prepare ・・・・ VR for virtual evacuation trainings simulate and verify the occurrence of a disaster

3_Experience ・・・**SYNCVR®** Understanding building design grade through earthquake simulation

4_When the shaking stops・・・**NSmos ®** Understand the building condition after an earthquake and use it for actions, instructions, and early recovery




**NS Wave®**



**VR for virtual evacuation trainings simulate**


**SYNCVR®**


**NSmos ®**

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# Earthquake Resilient System（SOFT） SYNCVR ®

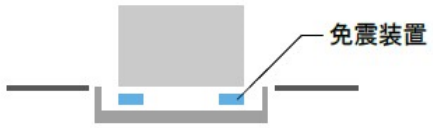
## Visualize the difference between Seismic Resistance Str. / Seismic Isolation Str. with VR movies

一般建物

Seismic Resistance Structure


免震構造

Seismic Isolated Structure





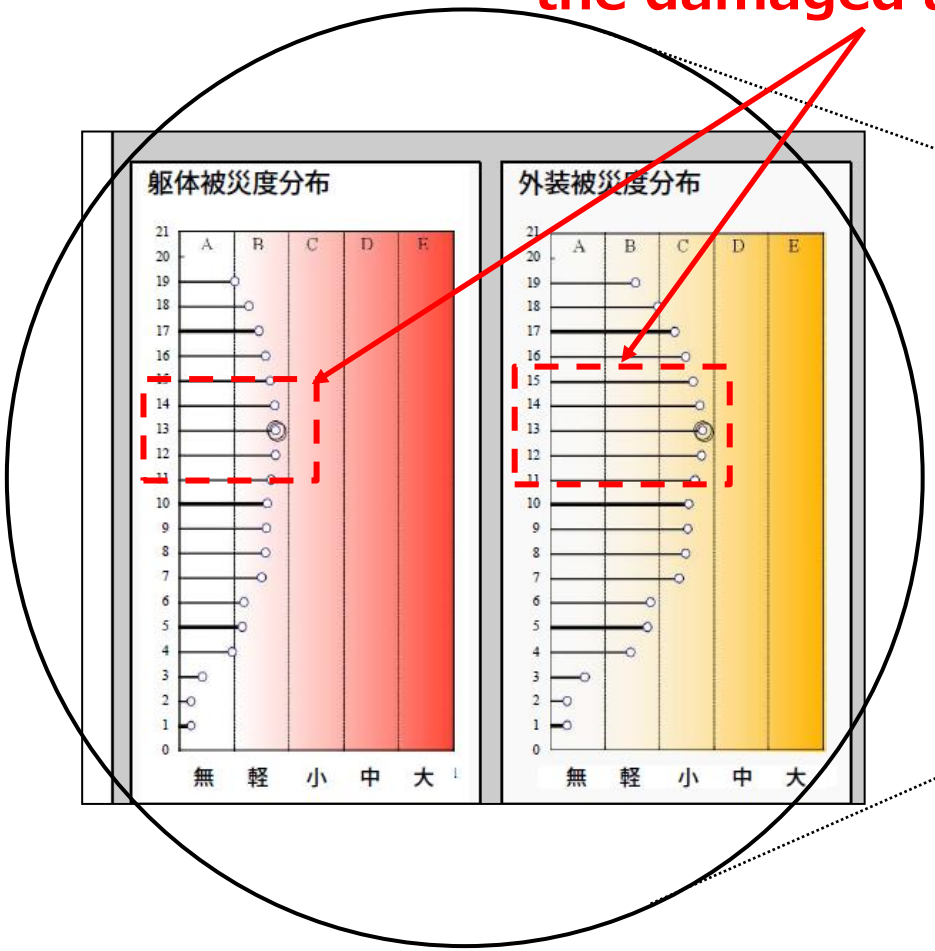
Reproduce earthquake shakes with SYNCVR®

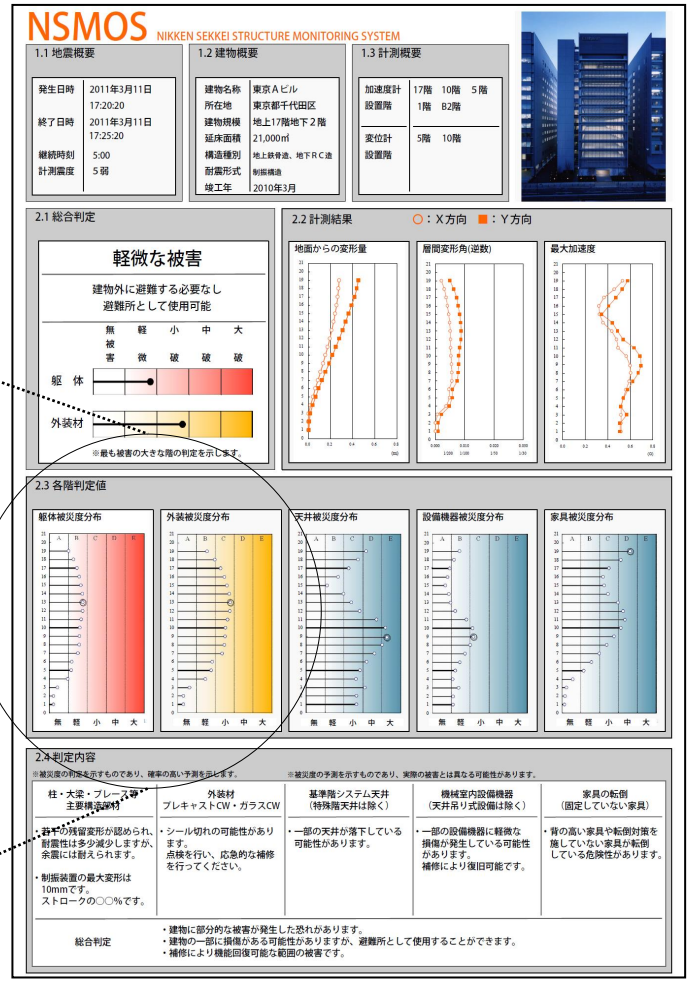
# Earthquake Resilient System（SOFT） NSmos®

Analyze the shaking with sensors in the building

and display a report in 1~2 minutes

**Instantly identify the damaged area!**



# Summary

◆Resilience = Robustness + Recovery

◆Resilience improvement = HARD + SOFT

◆HARD : Earthquake-Resistant Design : Seismic Isolated Str. and Vibration Control Str.

◆SOFT :

| | |
|---|---|
| 1_Earthquake wave estimation | NS Wave® Artificial earthquake waves considering faults and ground |
| 2_Preparation | VR for virtual evacuation trainings simulate and verify the occurrence of a disaster |
| 3_Experience | SYNCVR® Understanding building design grade through earthquake simulation and use it for actions, instructions, and early |
| 4_When the shaking stops | NSmos® Understand the building condition after an earthquake recovery |

◆Effects to enhance resilience

By disclosing evaluation results, the value is clarified and generates return on investment, in addition to protecting human life and property.

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