

JSCA's EFFORTS ON THE SAFETY OF NON-STRUCTURAL ELEMENTS

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Introduction

- (1) In Japan, the seismic performances of **building structural members** have remarkably reduced after the seismic code revision in 1981.
- (2) As for the **non-structural elements** such as ceilings (suspended ceilings), claddings, partition walls and building equipment, there are less seismic codes or regulations and their seismic performances are not good. They have received seismic damages at every big earthquake.
- (3) Especially, we have experienced many seismic damages of non-structural elements by **The Great East Japan Earthquake 2011**, in spite of less structural damages. Many seismic damages such as ceiling-falling have occurred widely and people were killed by them in some case.

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Introduction

(4) JSCA's policy is that **the reduction of non-structural element damages** is very important and JSCA has started to make up the seismic recommendation for non-structural elements.

(5) JSCA published these recommendations showed below.

a) June 2012 JSCA's proposal

“Lessons from The Great East Japan earthquake 2011”

b) June 2014 JSCA's proposal

“To secure the seismic safety of non-structural elements”

c) 2016 and future (Proposal by JSCA, JIA and JAMBEE)

“Proposal to secure seismic safety of non-structural elements”

“Examples of particular specifications for the safe non-structural elements”

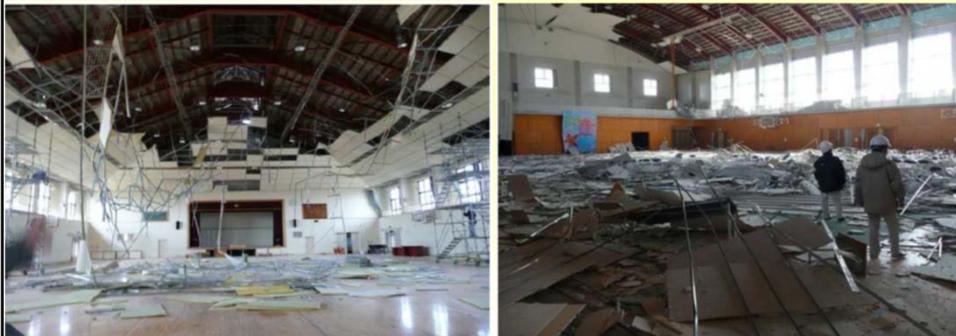
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Seismic Damages of Non-structural Elements

Seismic damages of The Great East Japan Earthquake 2011



Photograph 1 Falling down of gymnasium ceiling

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Seismic Damages of Non-structural Elements



Photograph 2



Photograph 3

Damage of ALC partition wall Damage of expansion joint wall

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Seismic Damages of Non-structural Elements



Photograph 4

Overturning of furniture



Photograph 5

Damage of escalator

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JSCA's proposal, June 2012

After The Great East Japan Earthquake 2011, JSCA started to examine the details for the seismic damages of structural members and non-structural elements.

The damages caused by Tsunami were so remarkable but the study was carried out mainly for damages caused by seismic vibrations.

The proposal was made up for structural members and non-structural elements.

The proposal commented for not only **structural-engineers** but also **building-engineers, equipment-engineers (building-equipment-engineers), construction-engineers** and the **society**.

(2)

JSCA's proposal, June 2012

1) Role of structural-engineers

- a. Structural-engineers do the design of supporting member, if non-structural elements such as precast concrete panels or ALC panels (Autoclaved Lightweight Concrete) are not supported directly by structural members.
- b. Structural-engineers do the design of supporting members of big ceilings or special claddings.

2) Advise and information for building-engineers, building-equipment-engineers and construction-engineers.

- a. For the design of non-structural elements, structural engineers provide the information about the building structures such as the design force, story drifts and floor responses.
- b. Structural-engineers advise for the design and detail of non-structural elements.
- c. Structural-engineers advise for the fixing method of the unstable furniture and equipment.

(2)

JSCA's proposal, June 2012

3) Role of building-engineers

- a. Building-engineers and construction-engineers should design and select the details of general non-structural elements.
- b. Building-engineers should express the seismic specification of non-structural elements in design documents. And final details of them should be decided at construction stage.

4) At the construction stage

- a. It is important that structural engineers confirm the construction drawings and construction-method. It is necessary to make up the confirmation system at the construction stage.

5) Necessity of the assessment and check for existing buildings

6) Required new detail development

- a. It is required that the detail of non-structural elements must follow this assumed story drift. These details should be developed and the information about story drift following capacity should be published.

(3)

JSCA's proposal, June 2014

In June 2012, JSCA proposed for about the technical issues and how structural-engineers, building-engineers and construction-engineers should be related to design and construction of non-structural elements.

After The Great East Japan Earthquake 2011, many groups such as the government, AIJ and BCJ (The Building Center of Japan) have started to revise the code and standards.

JSCA intended to make **the engineer's role clear.**

Every building engineer's role should be to change the target from "seismic structures" to "seismic buildings".

(3)

JSCA's proposal, June 2014

1) Safety of non-structural elements

Structural-engineers, building-engineers must work more to get the better seismic performance of non-structural elements after The Great East Japan earthquake 2011.

2) Role of building-engineers

Building-engineers should mainly work to get the seismic safety of non-structural elements by the aids of structural-engineers and equipment-engineers.

3) Roll of structural-engineers

Building-engineers should do the seismic design mainly when non-structural elements suppliers can support fully for seismic non-structural elements.

But, structural-engineers should do the seismic design for non-structural elements when the higher-level structural knowledge or the structural calculation is required.

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JSCA's proposal, June 2014

4) Role of engineers

For one project, many engineers are involved such as building-engineers, structural-engineers, equipment-engineer, supervising-engineers, construction-engineers and non-structural elements suppliers.

Each engineer should do his role at the design and construction stage.

In order to do this, they must discuss and decide what an engineer should do to get good seismic performance of a non-structural element.

In that case, the perimeter of each engineer's role should be covered by other engineer. Figure 1 shows the example of the cooperation work image for non-structural elements design.

5) Design document of non-structural elements

In some cases, the details of non-structural elements cannot be decided at design stage. For this case, engineers should describe the performance specifications of non-structural elements in the design document such as the particular specification.

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JSCA's proposal, June 2014

4) Role of engineers

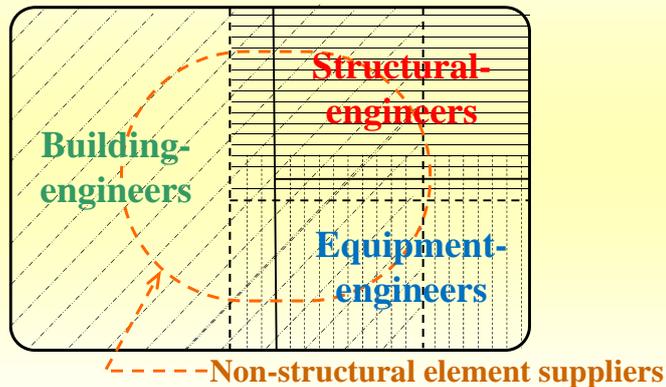


Figure 1 Cooperation image for seismic design of non-structural elements

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JSCA's proposal, June 2014

6) Regal affairs

Because of regal requirements, structural-engineers must examine the safety of special ceilings, roof members, curtain walls, water vessels on the roof, chimneys, hot-water supply equipment and so on.

These are increasing by seismic damage experiences. But some of them do not need structural knowledge and structural engineers cannot confirm details at design stage, because their actual details are decided at the construction stage.

The non-structural element code requirements for structural-engineers should be reduced considering that structural-engineers work mainly on structural engineering. From this, the total quality of building safety should be increased.

7) Increased design works

The seismic design works and regal procedures for non-structural elements such as special ceilings are increasing compared with the past. Project managers or architects should propose for clients to increase the design fee with increased design works. The reward of structural engineering should be increased when structural-engineers-works are increased by the design of non-structural elements.

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8) Knowledge of non-structural elements

Building-engineers, structural-engineers and equipment-engineers should effort to get more technical knowledges of non-structural elements.

Each related association should supply the information required.

Structural-engineers should understand not only structural calculation methods but details of non-structural elements.

JSCA published "JSCA standard for the design and practice for non-structural elements", which contains mainly the details to attach non-structural members to structural members.

9) Attached table

As examples, ceilings, claddings, partition walls and building equipment are picked out. In this table, the rolls of building-engineers, structural-engineers, equipment-engineers, supervising-engineers and construction-engineers, are listed at the design and construction stage. According to this table, every engineer should decide the detailed works to do after full discussions.

Table 1 Appendix table of JSCA's proposal (Example for ceiling)

	Ceiling	
	Design stage	Construction stage
Items of design and construction document		
Building designer		
Structural-engineer		
Equipment-engineer		
Supervising-engineer		
Construction-engineer		

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Common proposal, scheduled in 2016

Three associations of **JSCA**, **JFAA** (Japan Federation of Architects Associations) and **JABMEE** are working for revising JSCA's proposal, the attached tables and example particular specifications of non-structural element safety. In recent time, these shall be published by three associations.

In Japan, building-engineers, structural-engineers and equipment-engineers make up the design documents for individual parts. Usually the building particular specifications are made by the architect or building-engineer and **the seismic performances of non-structural elements are not described.**

On the discussion, the connection details shall be shown in the drawings and the performances should be expressed in the particular specifications. **Three associations decided to make up the common particular specifications.**

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Common proposal, scheduled in 2016

Particular specifications consist of two parts of **building non-structural elements and building equipment.**

As for **the building non-structural elements**, seismic performance such as design loads and deformability for story drift are required. In addition, wind load performances, snow load performances and the clearance of expansion joint are included. The stresses of non-structural elements and their attachments should be less than the short-term allowable stresses for the very rare earthquake.

As for **the building equipment**, supporting member stresses should be less than short-term allowable stresses for the very rare earthquake loads.

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Conclusion

On the experiences of The Great East Japan Earthquake 2011, MLITT (Ministry of Land, Infrastructure, Transport and Tourism) published new codes (public notifications) for special ceilings (higher position and large area) and escalators because of the experience of human life damages. But **these new codes are not sufficient** to reduce the non-structural elements damages.

JSCA has worked individually to secure the seismic performances of non-structural elements after The Great East Japan Earthquake 2011.

We hope that seismic damages of non-structural elements are decreased and total building seismic performances are improved utilizing **JSCA's proposals, JSCA recommendations and the particular specifications at 2016.**