第 17 回日米 +NZ 構造設計協議会

17th U.S.-Japan-New Zealand Workshop on the Improvement of Structural Engineering and Resilience
Queenstown, New Zealand
November 12-14, 2018

JSCA 国際委員会委員　長田亜弥

第 17 回日米 +NZ 構造設計協議会が、2018 年 11 月 12 日から 14 日の日程でニュージーランドのクイーンズタウンで開催された。この会議は米側 ATC(Applied Technology Council) と日側 JSCA((一社) 日本建築構造技術者協会) により企画運営され、1984 年から開催されているもので、原則 2 年に 1 回開催されてきた。JSCA においては、国際委員会(委員長川村満) の下に日米部会が設けられており、今部会を中心に準備運営が図られている。

今回は、前回会議に第三国として参加したニュージーランドの QUAKECORE(NZ Centre for Earthquake Resilience) と New Zealand Society for Earthquake Engineering が正式メンバーに加わり、ホスト国として運営して頂いた。

今回参加者は、日側 23 名、米側 18 名、NZ 側 21 名の計 62 名で、常連メンバーに産官学の新規参加者を加えて活発に議論を交わした。メンバー構成は、産官学 45:15:40 程度の割合であり、以前に比べてアカデミックな傾向もあった。

34 年前の第 1 回から全 17 回参加は寺本隆幸名誉教授一人であったため、会議の最後には会場から拍手が贈られた。

今回は論文申込み数が会議時間に比して多く、3 か国の運営委員で検討の結果、本会は単なる発表会ではなく WORKSHOP で、深い議論をする場であるとの主旨を考慮し、件数を抑える事とし、全体のバランスと各内容を鑑み論文の査読採否を行った。会議ではここ数回 Resilience(復旧性能がほぼ適切な訳と考える) をテーマに取上げており、今回も同様であった。

論文発表は 5 セッション、日 19、米 14、NZ 15 の計 48 編で、各セッションごとの討議と全体の最後にまとめの討議が設けられた。会議全体の Co-chair は、米 ATC Veronica Cedillos、日 JSCA 川村満、NZ Ken Elwood で、内容はおよそ以下の通りであった。

1. 11 月 12 日(月)

- **Session I : Innovative Structural Design for Large or Multiple Earthquakes**

1-1. Control Effect of Large Tuned Mass Damper Applied to Existing High-Rise Building for Seismic Retrofit; A. Haneda (Jp)

1-2. Proposed Low Damage Design Guidance — A NZ Approach; P. Campbell (NZ)

1-3. Partially Isolated Structure Dynamics Under Random Excitation; I. Nishimura (Jp)

1-4. Recent Progress in North American Research on Seismic Resilient Wood Buildings; A. Iqbal (US)

1-5. 12 Projects over 12 Years: Reflections from Implementing Low Damage Designs; A. Cattanach (NZ)

1-6. Realization of Ultra High-Rise Mixed-Use Building in Which RC Columns and CFT Columns are Connected with Rigid Joints; N. Ozawa (Jp)

1-7. Structural Design of Unprecedented Large RM (Reinforced-Masonry) Structure in Japan; T. Shitanishi (Jp)

1-8. Rocking Walls with Lead Extrusion Dampers Protect Formerly Homeless Seniors from Earthquake Risks; D. Mar, G. Rodgers (US, NZ)

1-9. Vibration Control of RC High-Rise Building with Soft-Story; T. Tani (Jp)

1-10. Improving Post-Tensioned Rocking Bridge Columns for Large and Multiple Earthquake Events; R. Liu (NZ)

1-11. Seismic Isolation Standard for Continued Functionality; V. Zayas (US)

1-12. Development and Application of System to Reduce the Excessive Tensile Forces Arising in Laminated Rubber Bearing; M. Uekusa (Jp)

- **Session II : Risk Identification and Reduction**

2-1. Lateral Instability of Ductile Structural Walls; State-of-the-Art; R. Dhakal (NZ)

2-2. Advantages of Using the Simplified Lateral Mechanism Analysis (SLaMA) Technique in the Assessment of New Zealand 1960s Reinforced Concrete Frame Buildings; J. Keen (NZ)

2-3. Progress Report of Seismic Evaluation and Retrofit of Old Buildings Located Along the Specific Emergency Transportation Roads in Tokyo; A. Osada (Jp)

2-4. NZ Loadings Standard (NZS1170.5) 2016 and 2018 Modifications to Structural Clauses for Increased Seismic Resilience; R. Jury (NZ)

2-5. Design Implications for Earthquake Duration on

Concrete Bridge Columns; D. Sanders (US)

2-6. Development of Planning and Design Guidance for Tsunami Vertical Evacuation Structures in New Zealand; J. Tipler (NZ)

2-7. Experimental Study on Damage Reduction Seismic Retrofit Technique for RC Frame Using Ultra High Strength Fiber Concrete; T. Mukai (Jp)

2-8. Study on How to Consider Pile Foundation Performance when Setting Seismic Performance of Building; T. Umeno (Jp)

2-9. Shear Capacity for Full-Scale Precast Concrete Pile; H. Watanabe (Jp)

2-10. Towards a New Delivery Approach to Improve the Performance of Non-Structural Elements in New Zealand; J. Stanway (NZ)

2-11. Development of Seismic Performance Objectives for Nonstructural Components; A. Hortacsu (US)

2-12. Nonstructural Earthquake Damage and Design Guide as Countermeasures in Japan; H. Ito (Jp)

2. 11 月 13 日 (火)

- **Session III : Resilience - and Performance - Based Engineering Progress and Developments**

3-1. Moving Toward Cities Where Earthquakes will Not Cause a Grievous Disaster; A. Wada (Jp)

3-2. Resilience: Challenges and Opportunities; M. Comerio (US)

3-3. A Time-Dependent Model for Seismic Risk Reduction Policy Analysis; M. Rabonza (US)

3-4. A Seismic Building Rating System — the New Zealand Experience ; H. Ferner (NZ)

3-5. Applying Resilient Rating Systems for Predicting Continued Operability of Hospitals After Earthquakes; M. Boston (NZ)

3-6. Research and Development on Safety of Buildings Against Natural Disasters and Urban Fires at the Building Research Institute; M. Midorikawa (Jp)

3-7. Resiliency Evaluation of Reinforced Concrete Buildings; S. Kono (Jp)

3-8. Key Implementation Challenges and Crosscutting Research Themes for Developing Immediate Occupancy Performance Objectives; S. Sattar (US)

3-9. The Serviceability of Resilient Seismic Design in New Zealand; D. Pettinga (NZ)

3-10. Evolution of Resilience — Based Design of Infrastructure; P. Brabhaharan (NZ)

3-11. Earthquake Disaster Prevention and Required Performance of Railway Facilities in Japan; A. Hayashi (Jp)

3-12. Modeling Community Resilience: Update on the Center for Risk-Based Community Resilience Planning and the Computational Environment IN-CORE; J. van de Lindt (US)

- Session IV : Earthquake Response, Recovery, Repair, and Reconstruction

4-1. Lessons on Attaining Resilience Based on the Christchurch Rebuild Structural Form Drivers Study; G. MacRae (NZ)

4-2. Connecting Physical Damage to Social and Economic impacts; S. French (US)

4-3. Research on Seismic Evaluation and Retrofit of Condominium in Japan; T. Nakano (Jp)

4-4. Effectiveness of Repair via Epoxy Injection of Earthquake Damaged Reinforced Concrete Beam Elements; K. Elwood, M. Sarrafzadeh (NZ)

4-5. Quantify Earthquake Disaster and Affect Disaster Response Policy to Improve Citywide Resiliency; S. Kast, K. Miyamoto (US)

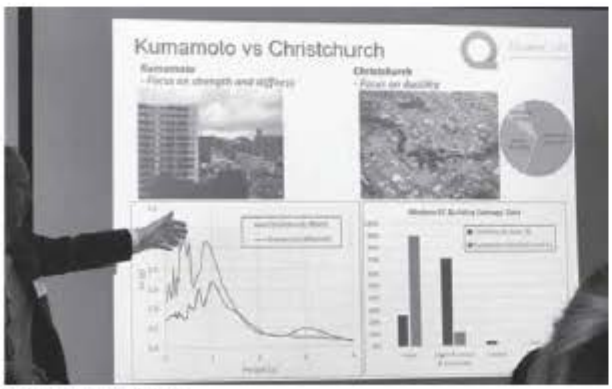

写真 1　論文発表の様子
Photo1　Scene of presentation

写真 2　Discussion の様子
Photo2　Scene of discussion

3. 11 月 14 日(水)

- **Session V : Lessons Learned from Recent and Past Events**

5-1. Observed Response of Seismically Isolated Buildings During the 2016 Kumamoto Earthquake; M. Takayama (Jp)

5-2. Statistical Analysis of Building Damage in Japan Based on the 2016 Kumamoto Earthquake; F. Yamazaki (Jp)

5-3. Building Management in Emergencies: An Update on New Zealand Arrangements; D. Brunsdon, M. Stannard (NZ)

5-4. Zoning Verification in Mexico City Using Strong Motions of the M7.1 Puebla-Morelos Earthquake of September 19, 2017; M. Çelebi (US)

5-5. Structural Performance Factors and Building Damage Following the 19 September 2017 Puebla, Mexico Earthquake; E. Jampole (US)

5-6. On the Diversity of Design Criteria in Seismic Design; Y. Shinozaki (Jp)

5-7. Legal Rumblings in California High-Rises: Emerging Liability Patterns when Field Performance Falls Short of Design Predictions; M. White (US)

議事進行は、発表資料を ATC の Cloud 上にまとめ、順次展開して行き、スムーズであった。今回も前回同様、論文毎の発表 10 分＋質疑応答 2 分を続けて行い、各セッション終了後に全員で Discussion を行い、活発な意見交換を行った。Discussion 記録は、US Co-chair によりその場で文章化しスクリーン上に映し出す合理的で有効な方法が取られた。

最終日は、Closing Session にてセッション毎の Discussion 記録を全員で確認再検討し、Workshop のまとめを行った。なお、Discussion 記録は、後日 Findings & Recommendations として下記の通り 4 つのカテゴリーに整理され、発表論文、資料等と共に、ATC のホームページにて公開されている。(文中、各カテゴリーのキーワードのみ和訳して示す。)

Findings & Recommendations

#1 Research(研究)

- Continue to work on understanding residual capacity and repairability of buildings (topic touched upon at prior workshop).(残存性能、修復性)
- Further study the impact and revision of damping values.(減衰)
- Further investigate impact of duration and how to include it in the design process.(継続時間)
- Most reports on past events focus only on damage. We also need to report on good structural and nonstructural performance.(構造 / 非構造材の損傷以外の性能)
- Develop inspection methods to provide better confidence in identifying damage (e.g., steel moment frame damage following the Northridge earthquake). Requiring instrumentation for new buildings can help with this.(検査方法)
- Sites and their impact on performance need to be better assessed and documented. Identify what is causing damage. It might not just be ground shaking (also look at liquefaction issues, etc.).(敷地、地盤)
- We need better post-earthquake data on nonstructural performance (e.g., % of pipes broken and resulting impact).(非構造部材の性能)
- Investigate strategies for achieving resilience at wider scales (e.g., community - wide resilience).(広範囲のレジリエンス (復旧性能)、社会的)
- Frequency content of input motion to structures makes a big difference in impact. For example, performance of buildings in the Nepal earthquake was highly driven by frequency content. Design philosophy in Mexico is to avoid resonance.(地震動の周期性状)

#2 Engineering Practice(技術の実践)

- Explore new performance objectives, such as low damage design and functional recovery. We need to define these and consider their implications.(損傷制御、機能回復)
- Improve engineering designs/strategies to provide better performance at minimal or no extra cost. Encourage engineers to consider performance in their design decisions (e.g., selection of structural system).(性能と費用)
- There are very few buildings with seismic isolation in the U.S. In Japan, ductile design is very complicated and complex without a clear performance objective, but seismic isolation is simple and understandable in its performance. Consider reducing the R factor in the U.S. to simplify design and improve resilience.(免震対塑性設計、性能目標、Rファクタ)
- Consider how drift limits in the code impact resilience. There is inherent resilience in stricter drift limits.(変形制限)
- We need to improve resilience of nonstructural systems.(非構造材の復旧性能)

#3 Resilience Incentives(復旧性能への動機付け)

- We need to improve our communication to encourage

resilience.(コミュニケーション)

- Improve our understanding of cost of increased resilience so that we can communicate cost-benefit to stakeholders.(費用対効果)
- Explore how we can use market forces to drive resilience.(市場要求)
- Nonstructural performance can have big impacts on resilience. For example, a building may have good structural performance, but may be perceived as having inadequate performance by the public due to nonstructural damage.(非構造材の性能)

#4 Regulatory Environment/Policy(規則規制環境 / 方針)

- Our mission is for society. We should focus on the outcome for society.(社会性)
- We need to further understand acceptable risk. It can depend on many things, like insurance levels (e.g., acceptable risk in Christchurch might not apply in other areas).(リスク評価)
- Having legislation that supports our processes is important. Consider using videos of nonstructural damage to get support for better legislation and processes to improve resilience.(規則と支援)
- Even relatively new buildings become non-compliant because of changing codes are continuously updated for regulatory and/or structural safety/performance reasons – how do we deal with this issue that is more than just technical?(規則変更と不適格)
- Focus on the bigger picture–look at systems at the regional level, focus on improving new construction as there will always be growth, be realistic about improving the existing building stock while being conscious of the importance of keeping the existing building stock safe, and incorporate land use planning considering hazards.(既存、新築、地区開発計画)
- We are not policymakers, but should serve as advisors to policymakers. We need to tell our story well.(方針決定者、技術的助言)
- We continue to have the challenge of engaging decision makers (e.g., politicians) in the conversation around resilience. We need more compelling arguments (e.g., economic impacts).(決定者、説得資料)
- Lobby group of countries to highlight nonstructural performance issues and how they are enforced in different countries.(政治的活動)
- Consider targeting damage limits in the code instead of just focusing on collapse. If so, should consider liability for practicing engineers as overpromising can lead to a lot of issues.(目標損傷限界、技術者責任)
- Reconsider serviceability limit state / Level 1 in Japan.(使用限界状態)

本 WORKSHOP の側面として、前日に行う Ice breaker をはじめ、期間中の食事は基本的に参加者全員で取るなど、会議以外の場でも他国の参加者と積極的にコミュニケーションを図り、時に Discussion をして交流を深めることが出来る。大変意義深く、30 年以上継続してきた賜物と感じる。会議後、今後の日本側に望まれる課題が二点挙がった。

もっと積極的に Discussion に参加して欲しいということと、女性技術者を増やして欲しいということである。帰国後、日米部会にて検討を行い、一点目の Discussion については、討議議題の明確化や事前共有、準備等の改善を行い、二点目の女性技術者については、各方面へリサーチを行う予定である。また会議自体についても、参加者数増による討議方式の見直しなど複数点の課題が挙がったため、次回に向けて継続して準備を進めたいと考えている。

次回は US がホスト国となり 2021 年ハワイにて開催予定である。

写真 3 Discussion の様子
Photo 3 Scene of discussion

写真 4 参加者全員による記念撮影
Photo 4 Commemorative photo of all attendees