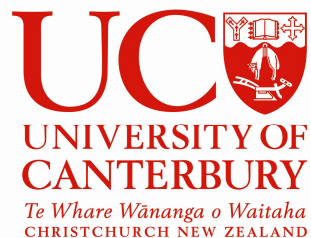


2013 National Lifelines Forum
6, 7 November
Auckland

***Projecting Damage and Losses for Buildings and
Infrastructures
from the Canterbury Earthquake Sequence***



Content and Scope and of the research

“ Taxonomies for the exposed assets

Create an Infrastructure Asset Compendium (e.g. for Pipes, Cables, Roads and bridges) into which infrastructural assets can be classified.

“ Taxonomies for Physical Damage and Consequential Loss

acquisition and interpretation of damage and consequential loss data experienced by a representative sample of infrastructure across Canterbury

“ Models for Physical Damage and Consequential Loss

create revised vulnerability, fragility and consequences functions for infrastructural typologies when subjected to earthquake-induced shaking and ground deformation

“ Maintain connection with the end-user group and researchers

to ensure analysis of data is not duplicated, result presentational style is in a form consistent with end-user expectations, limitations in the application of the data is understood by research and end-user groups.

“ Embed the resulting models into the RiskScape and other DM supporting tools

Content and Scope and of the research



Reinsurance Industry, Wider
end-user and scientific Community

Inventories Databases
Fragility Models
Loss Models
Screening tools

Effective Mitigation Strategies,
Planning



Lifeline Utility Managers

Projecting Damage and Losses for Buildings and Infrastructures from the Canterbury Earthquake Sequence

Methodology

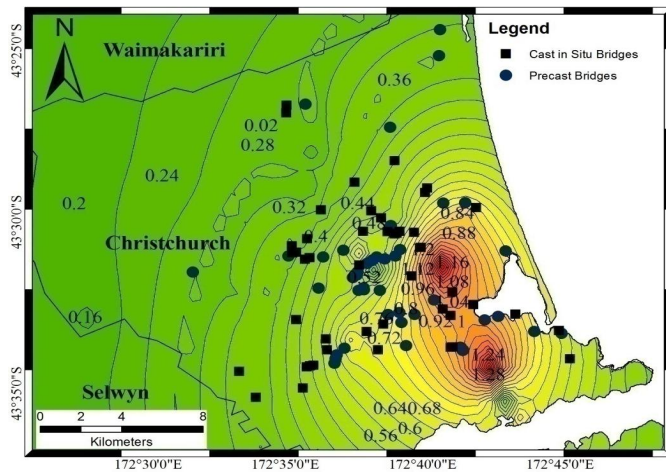
ANALYSIS OF FUNCTIONAL IMPACT

ANALYSIS OF PHYSICAL DAMAGE

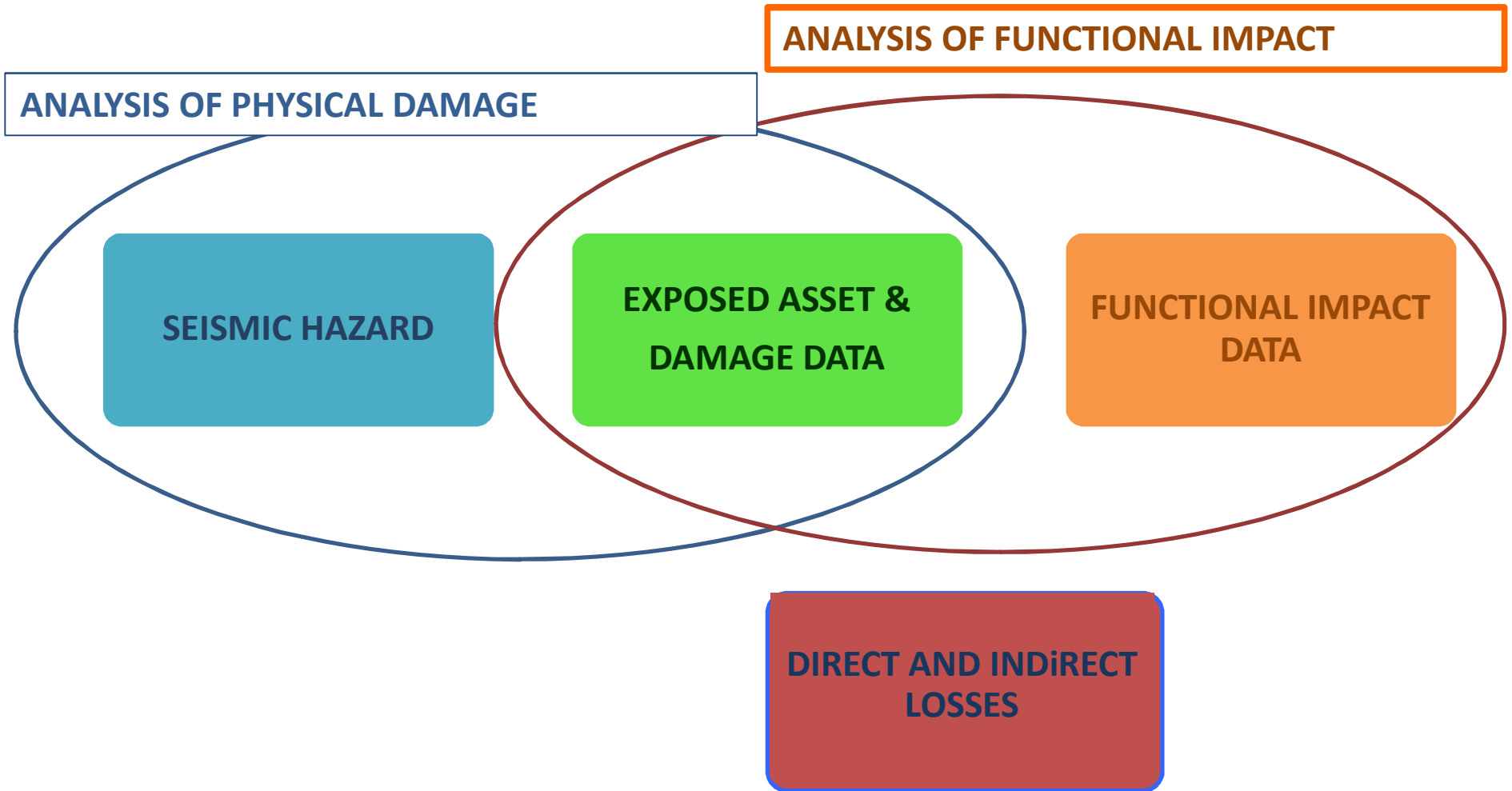
SEISMIC HAZARD

EXPOSED ASSET & DAMAGE

FUNCTIONAL IMPACT



Methodology



Participants and International Collaborations



Andrew King
Jim Cousin
Dr Mostafa Nayyerloo
Dr Sheng-Lin Lin
Dr Uma S R
Dr Nicolas Pondard



Dr Sonia Giovinazzi
and..



UME Graduate School
understanding and managing extremes



Stakeholder engagement

Results up to Date: few examples

Projecting Damage and Losses for Buildings and Infrastructures from the Canterbury Earthquake Sequence

Power Network Components

The effectiveness of existing **methodologies for predicting electrical substation damage** from ground shaking due to the September 2010 and February 2011 earthquakes



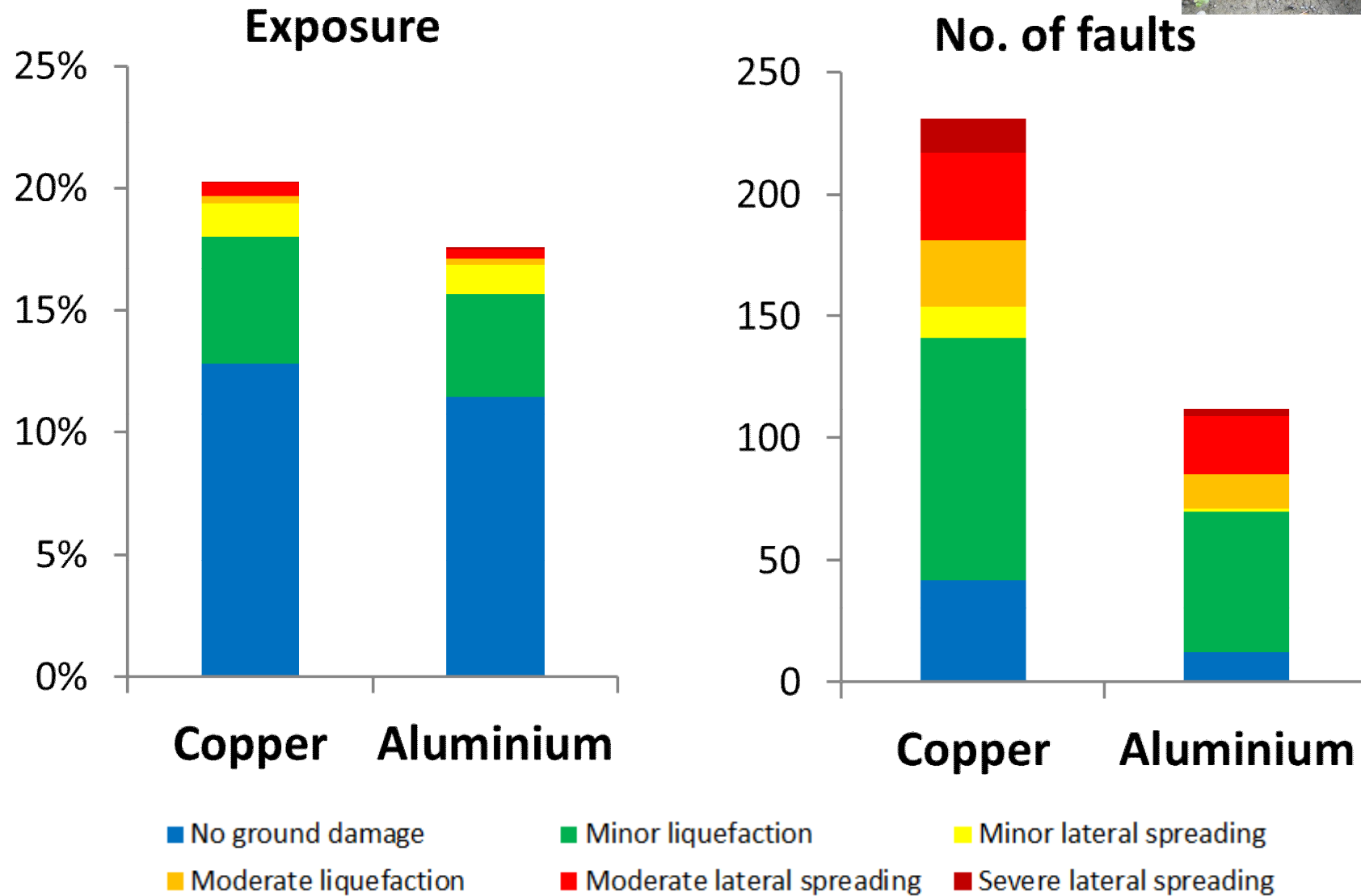
Analysis of **damage to 11kV electricity cables** in relation to the liquefaction impact from the September 2010 and February 2011 earthquakes



Indranil Kongar (University College London)

Network Analysis to be carried on in collaboration with UC EpeCentre to assess functional impact and losses induced by Physical Damage

Assessing vulnerability of 11kV to liquefaction



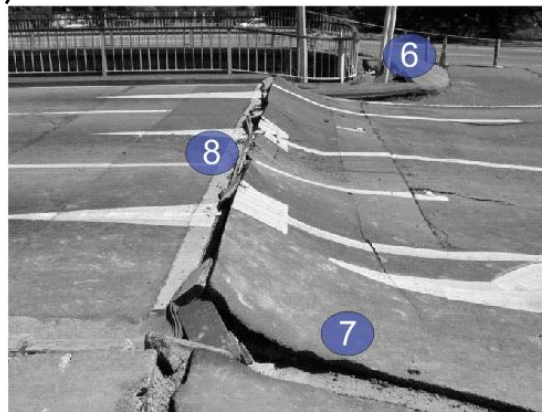
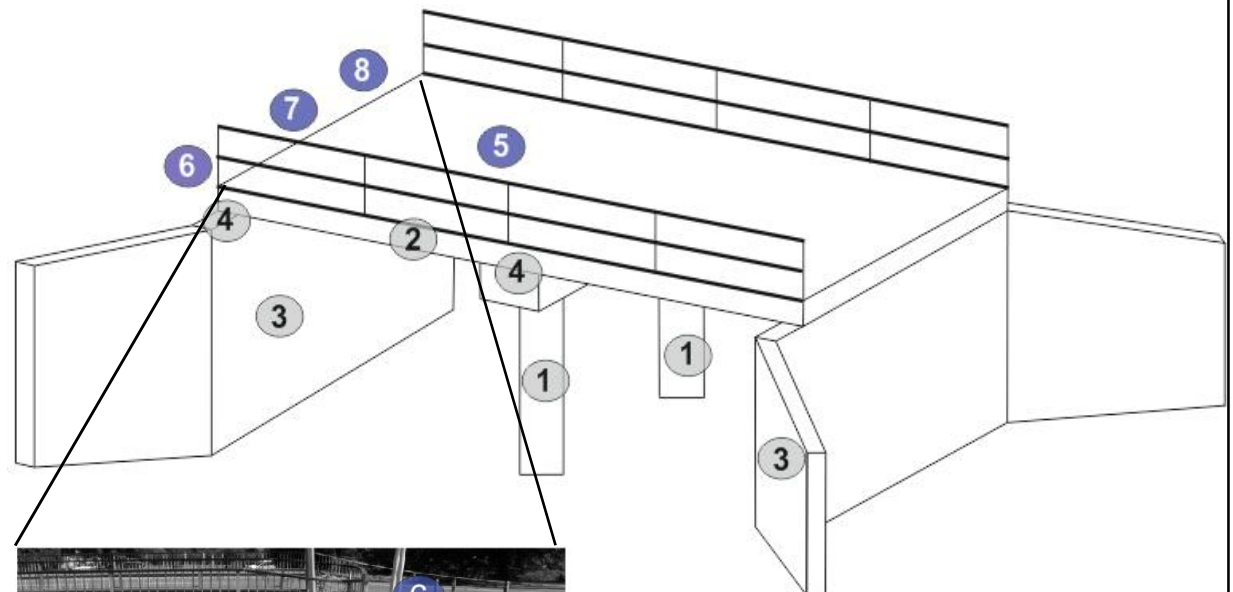
Tonkin & Taylor (2013)

Assessing Physical Damage and Functional Impact on Canterbury Bridge Stock

The Bridge Damage Database (BDD) .
Dr Alessandro Palermo

1. Piers;
2. Deck and superstructure;
3. Abutments;
4. Bearings;
5. Bridge pavement;
6. Surroundings and interaction zones;
7. Approach pavement;
8. Approach settlement;
9. Services.

Structural and **Non-Structural** components



Level of Damage

0 = No Damage

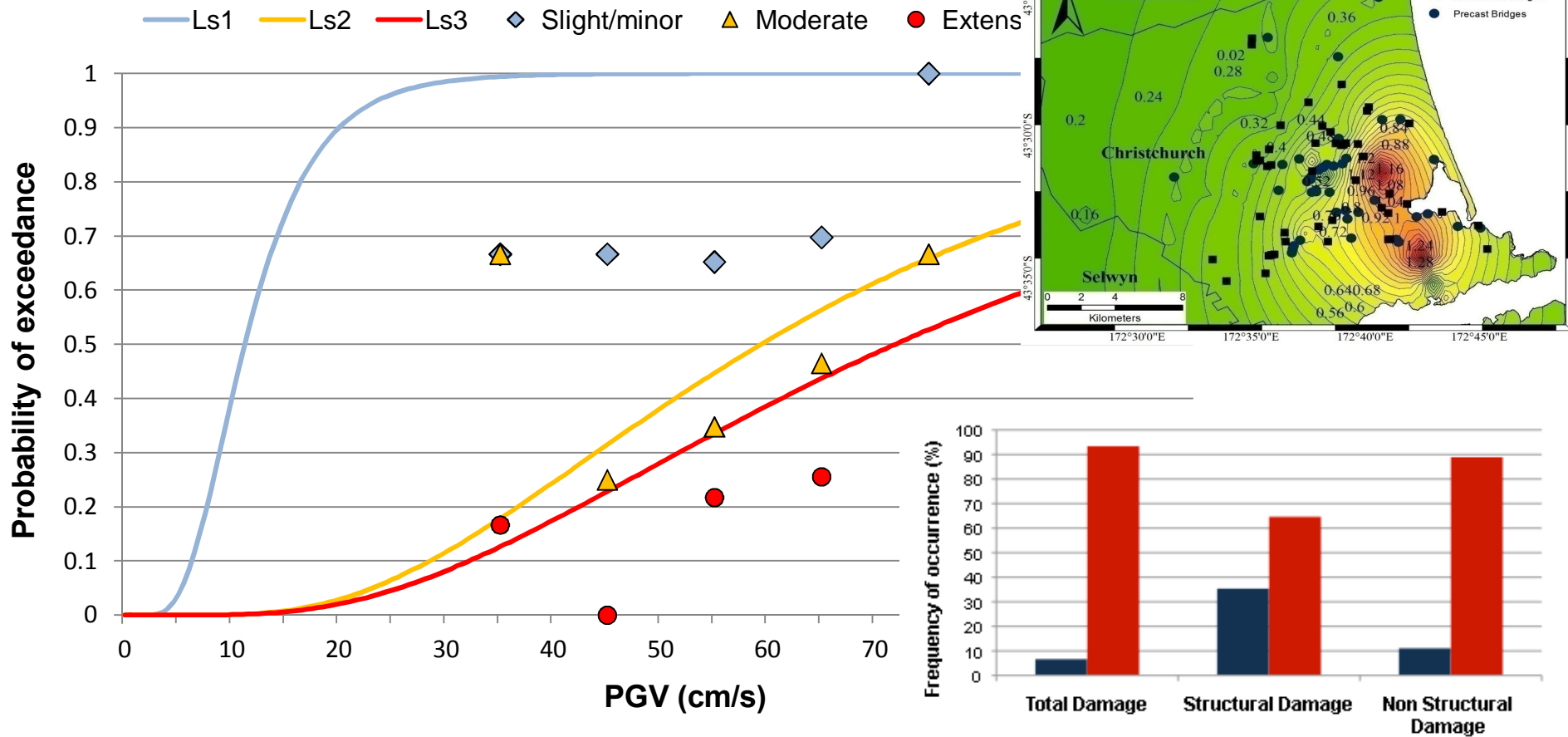
1 = Slight or Minor

2 = Moderate

3 = Extensive or Complete

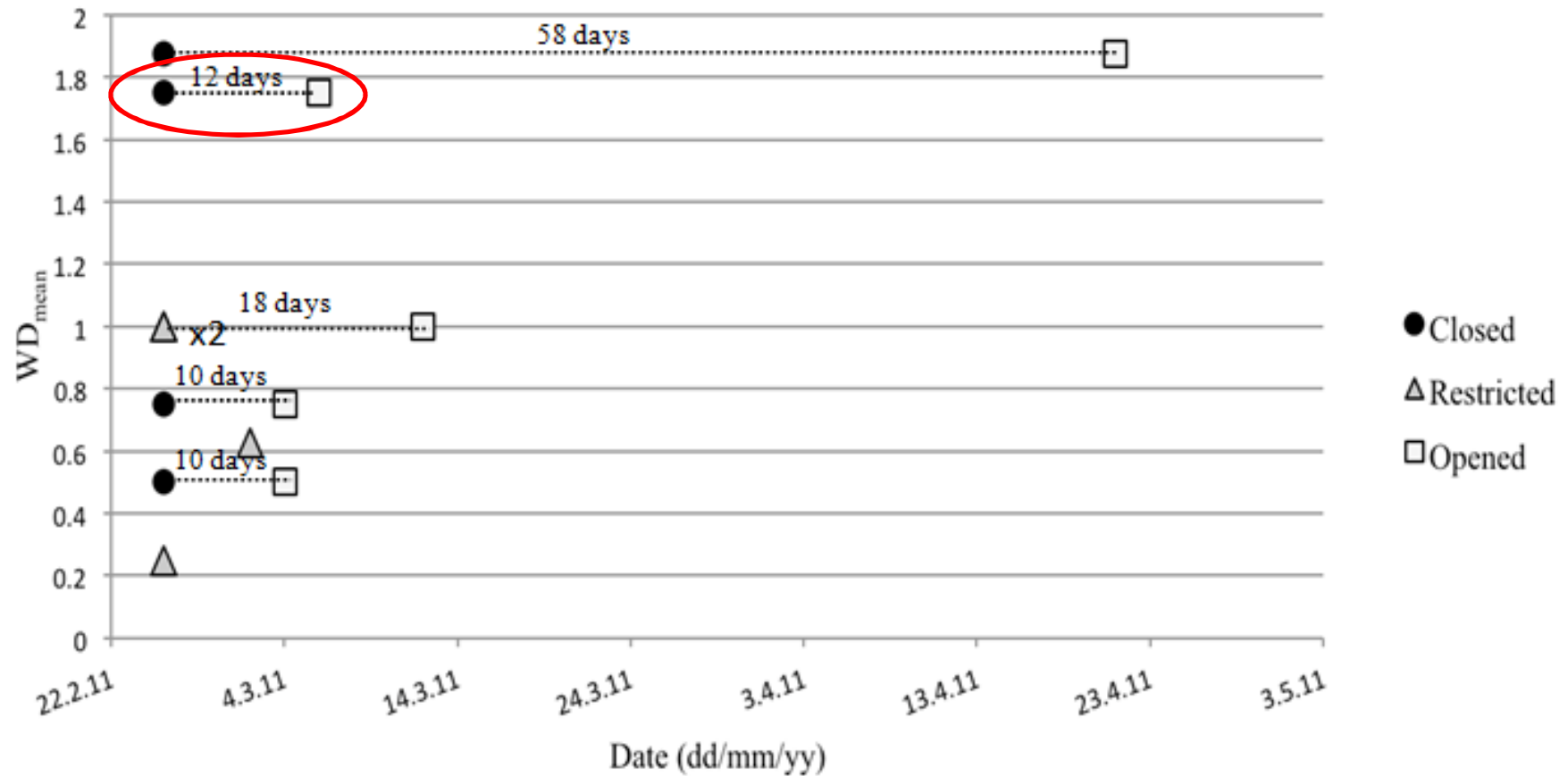
Analysis of Physical Damage

Concrete (Precast + Cast in Situ) TD_{max}



Probability of exceeding the TD_{max} damage states observed for the concrete bridges (precast + cast in situ) of BDD (scattered points) and reinforced concrete bridges in Turkey (continue lines) [Avsar *et al.*, 2011].

Analysis of Functional Impact



Bridges restoration time (from RAMM database) versus WD_{mean}

Analysis of Functional Impact

Damage state	Restoration time			
	BDD (WD_{mean} assumption)	BDD (WD_{max} assumption)	FEMA, 2003	Padgett & DesRoches, 2007
<i>Slight</i>	~ 2-3 days	~ 2-3 days	~1-3 days	~1 day
<i>Moderate</i>	~ 35 days	~ 3-4 days	~7-30 days	~7 days
<i>Extensive</i>	Not reached	~ 18 days	>90 days	>30 days
<i>Complete</i>	Not reached	~ 18 days	>90 days	>30 days

Restoration time (Time to restore the pre-event bridge functionality).
From the RAMM Database.