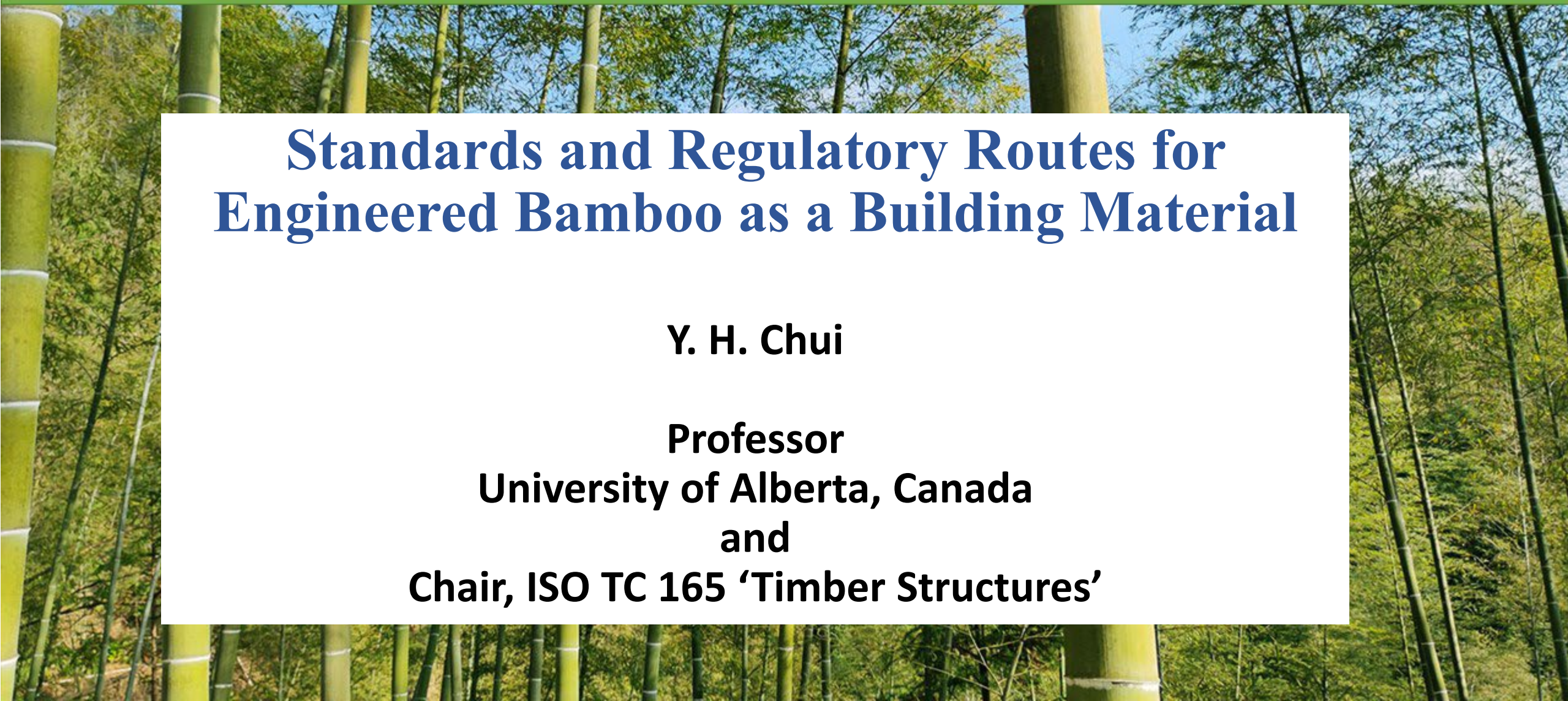
THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Forestry
WORLD BAMBOO
Engineered Bamboo for Sustainable Construction
May 17 – 19, 2022



Standards and Regulatory Routes for Engineered Bamboo as a Building Material

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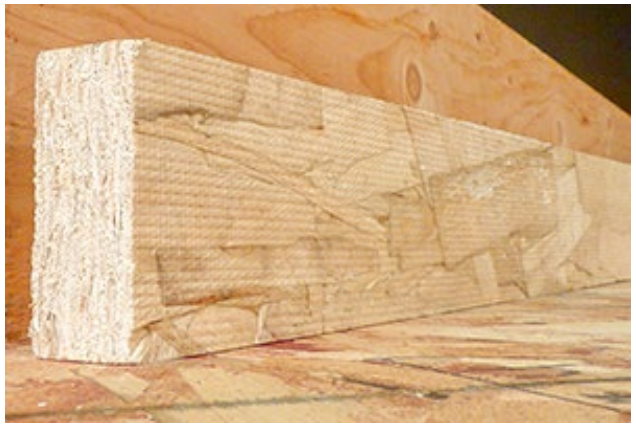
Professor
University of Alberta, Canada
and
Chair, ISO TC 165 'Timber Structures'

Engineered wood products in tall buildings

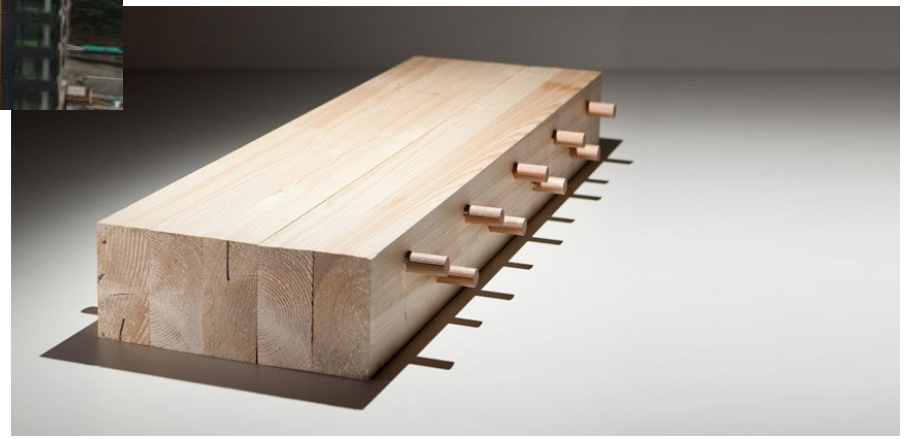
Cross Laminated Timber

Tallwood House, Vancouver – Main driver is ‘green’ credential of wood

Glulam

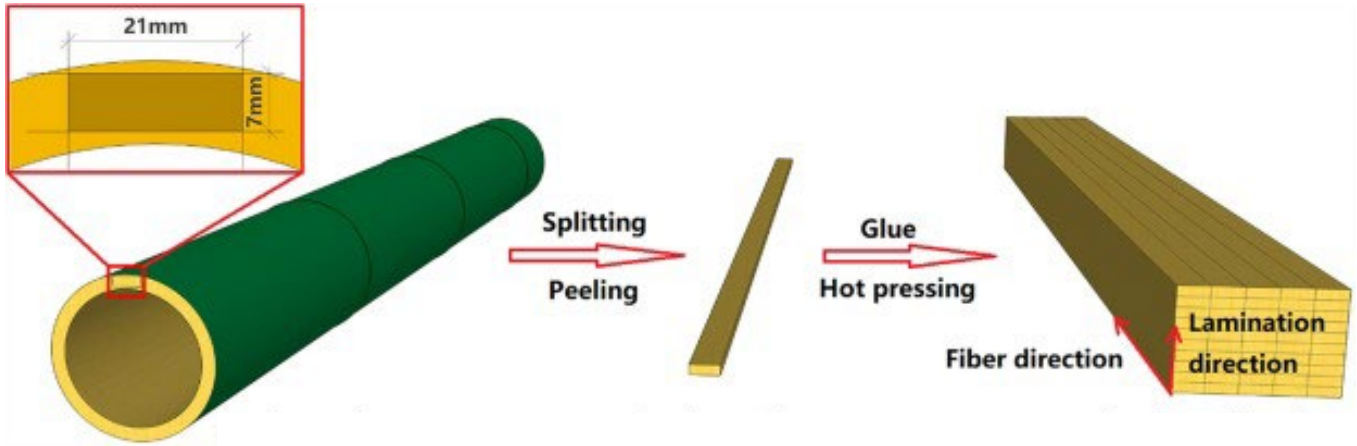


Structural Composite Lumber

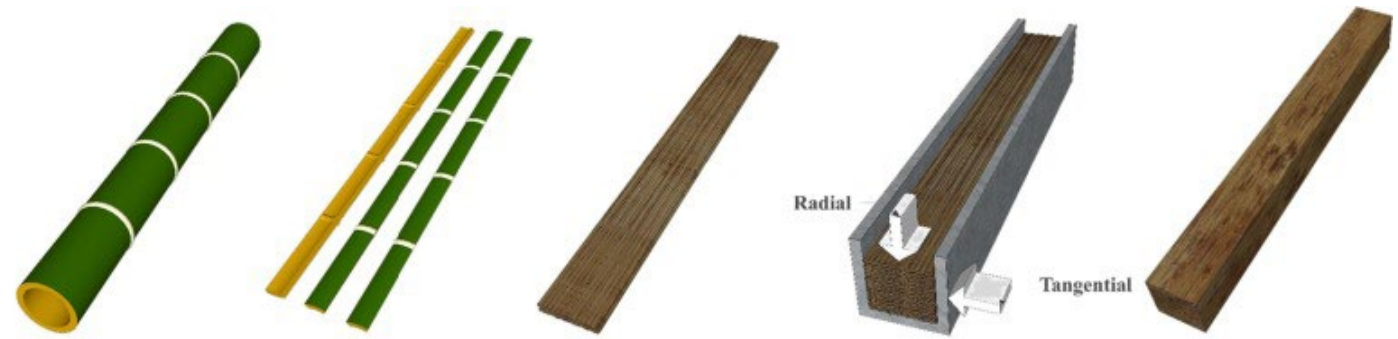


Dowel Laminated Timber

New generation of engineered bamboo composites



Bamboo culm | Bamboo strip | Laminated Veneer Bamboo



Bamboo culm | Bamboo strand | Strand bundle | Pressing in mould | Parallel Strand Bamboo

Acceptance through standardization and regulatory process is an essential step – ISO standardization process can play a key role

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This presentation

- Introduction of ISO standards development process
- ISO standardization for timber and bamboo products in structural applications
- Suggestion for engineered bamboo composites (EBC)

ISO Standard Development

- ISO develops standards that can be directly adopted or used as model standards by member countries
- Traditional key objective:
  - ➢To facilitate trading of products and services between countries → Harmonization of standards
- Newly added objective:
  - ➢ To contribute to realization of United Nation's SDGs by 2030 – affordable shelter, climate change, etc
    - ➢ Promotion of renewable, low carbon footprint material in construction would help achieve some of the SDG

ISO Technical Committees on Renewable Materials

ISO/TC 89 - Wood-based panels

ISO/TC 165 – Timber structures

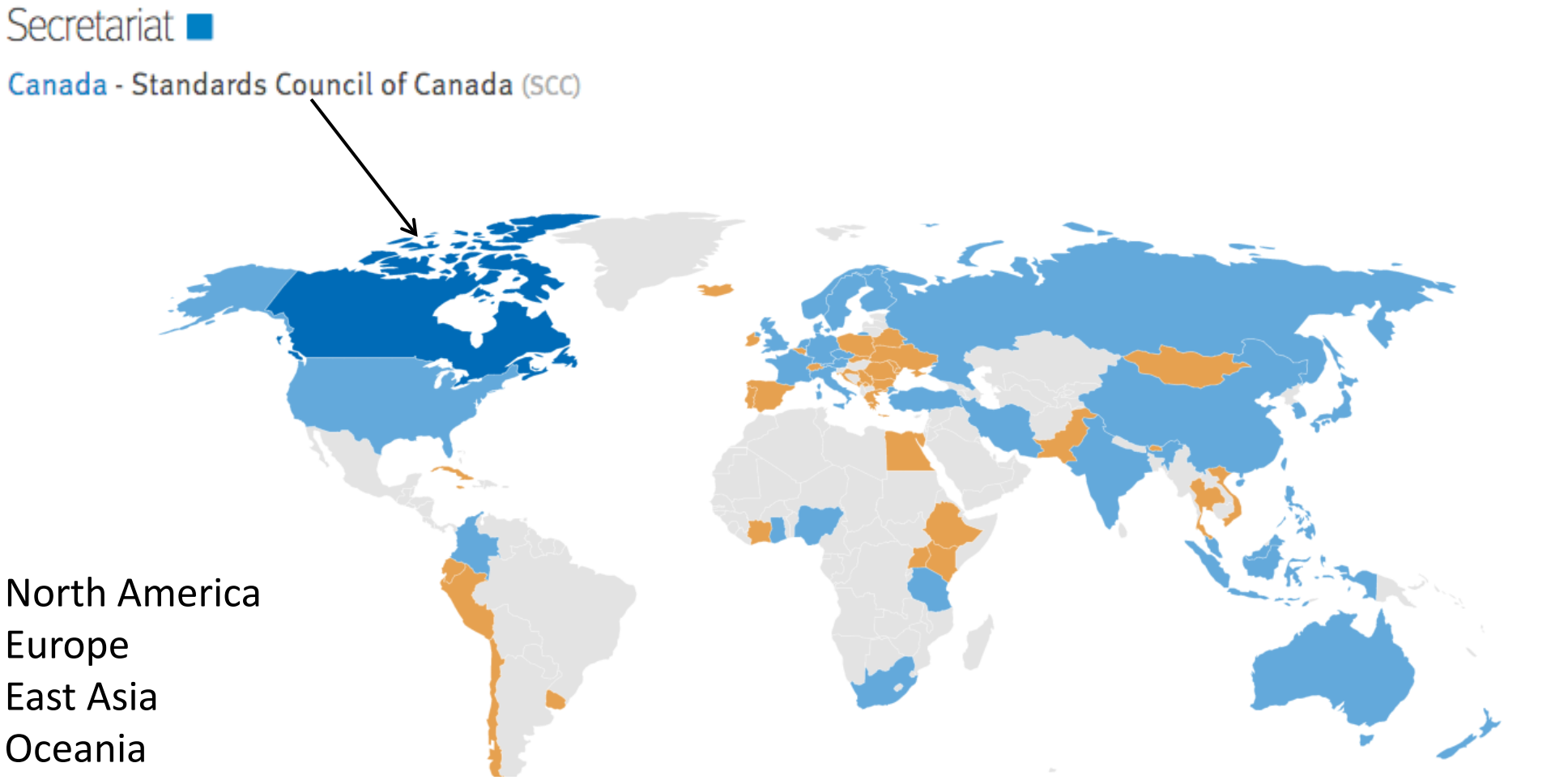
ISO/TC 287 - Sustainable processes for wood and wood-based products

ISO/TC 296 - Bamboo and rattan

Standardization concerning structural applications of wood based products, and related lignocellulosic fibrous materials (e.g. bamboo)

Sustainable structures / Green buildings

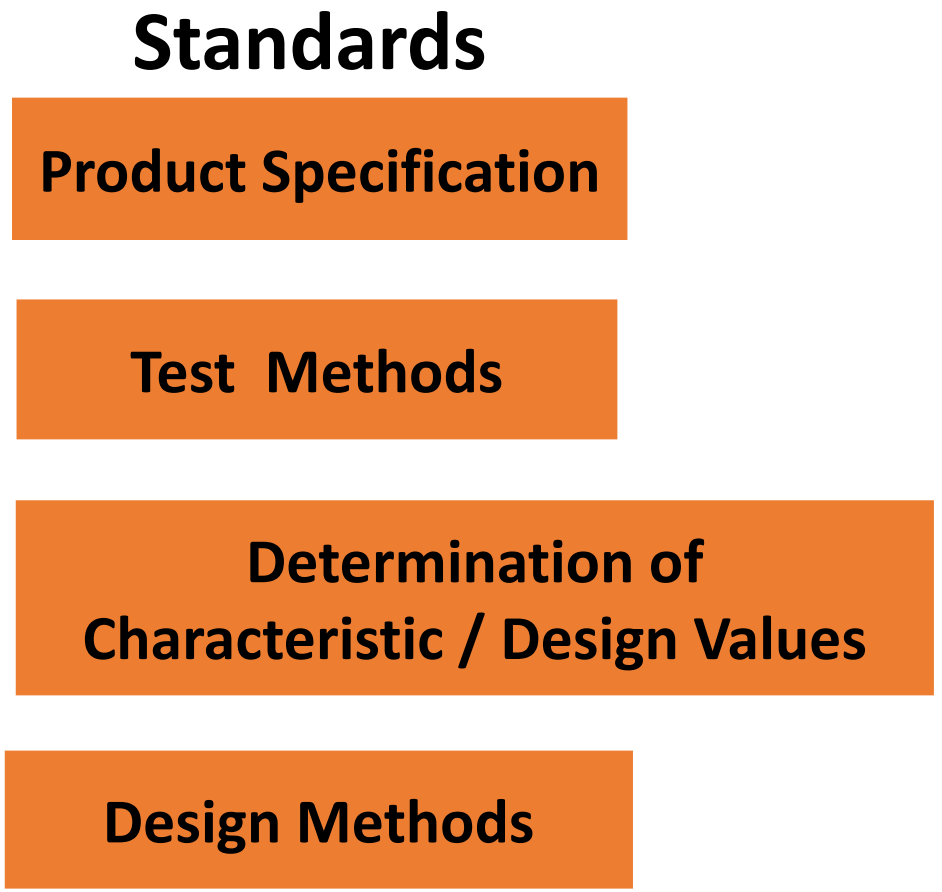
ISO TC 165 ‘Timber Structures’- membership



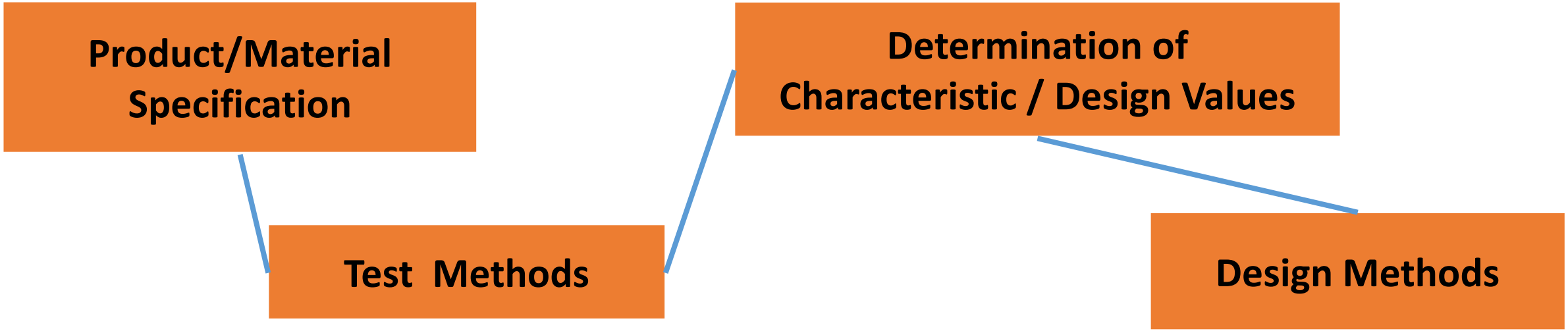
North America
Europe
East Asia
Oceania

Requirements for acceptance of a product by building/design codes

- Manufactured according to a product standard
- Tested according to standard procedure
- Test data evaluated according to accepted procedure to derive design properties
- Accepted design procedure

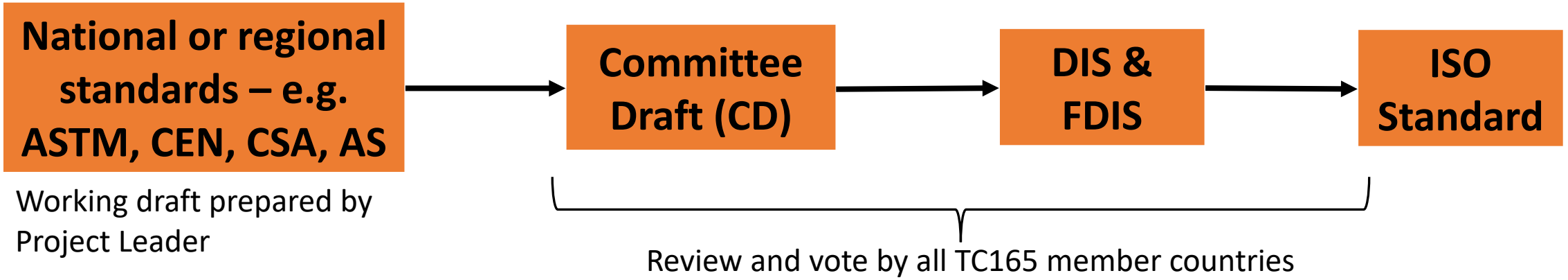


Four categories of standards published by ISO TC 165 'Timber Structures'



- Since 2013 bamboo products are included in scope
- To-date - 44 timber related and 3 bamboo related standards have been published

Typical process to develop timber-related ISO standards



Challenge

- Timber products have a long history of commercial production and each major producing country already has its own suite of standards:
  Manufacturing → Testing → Design Properties → Structural Design
- True harmonization of timber standards and therefore trade is often difficult to achieve

ISO TC 165 – Bamboo related standards (since 2013)

- Few national standards exist for structural bamboo products
- This is an area where ISO can play a leading role in developing truly harmonized international standards

Bamboo culm standards		
Product	ISO 19624: 2018	Grading of bamboo culms - Basic principles and procedures
Testing	ISO 22157: 2019	Determination of physical and mechanical properties of bamboo culms - Test methods
Design	ISO 22156 : 2021	Structural design

ISO TC 165 – Bamboo related standards under development

- Current projects focus on engineered bamboo composites (EBC)

Engineered bamboo composite related standards	
Product	Glued laminated bamboo – Product specifications
Testing	Engineered bamboo products – Test methods for determination of physical and mechanical properties
Design	Engineered bamboo products – Structural design

Suggestion for harmonization – Structural Class System for Engineered Bamboo Composites (EBC)

UNIVERSITY OF ALBERTA
NSERC CRSNG
NSERC Industrial Research Chair in Engineered Wood & Building Systems

Background experimental study

A comprehensive testing program conducted by National Engineering Research Centre of Biomaterials, **Nanjing Forestry University** to characterize mechanical properties of EBC.

Provenance	Age	Product	Adhesive
Jiangxi	4	LVB, PSB	Phenolic
Hunan	5	LVB, PSB	Urea-formaldehyde
Fujian	3-4	LVB	Phenolic
Sichuan	5	LVB	Phenolic

Example of Structural Class System for EBC - Characteristic property requirements

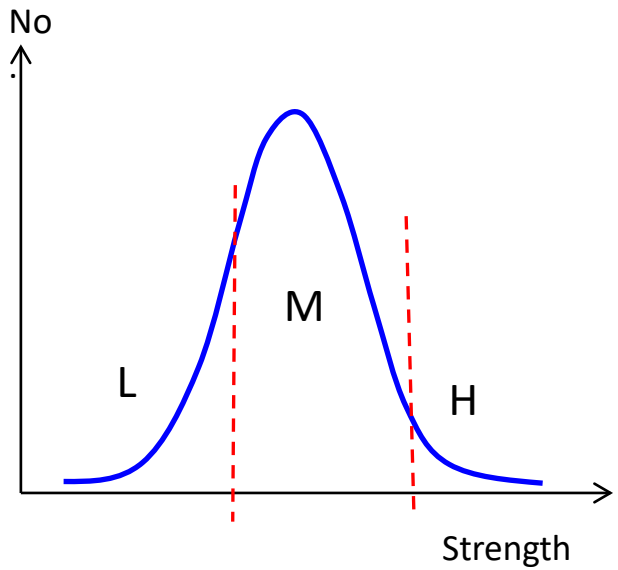
Property	Symbol	BC1	BC2	BC3	BC4
Bending strength	f_b (MPa)	10	14	18	22
Tensile strength	f_t (MPa)	6	10	14	18
Compression // strength	f_c (MPa)	8	12	16	20
Shear strength	f_v (MPa)	2	3	4	6
Compression perp strength	f_{cp} (MPa)	3	5	7	9
MOE	E (MPa)	10000	12000	14000	16000
Density	ρ (kg/m^3)	500	550	600	650

Benefits of a structural class system

Structural class	BC1	BC2	BC3	BC4
Product	Fujian LVB Hunan LVB Sichuan LVB		Jiangxi LVB	Hunan PSB Jiangxi PSB

Facilitate Harmonization of Standards and International Trade

- Benefits for end users
  - Specifiers and designers can easily substitute products
- Benefits for producers
  - Recognized properties to aim at
  - Can produce several grades from the same production – use of grading technologies



Thank you for your attention!