fib internationaal : de kans op toegang tot en beïnvloeden van internationale (beton)kennis

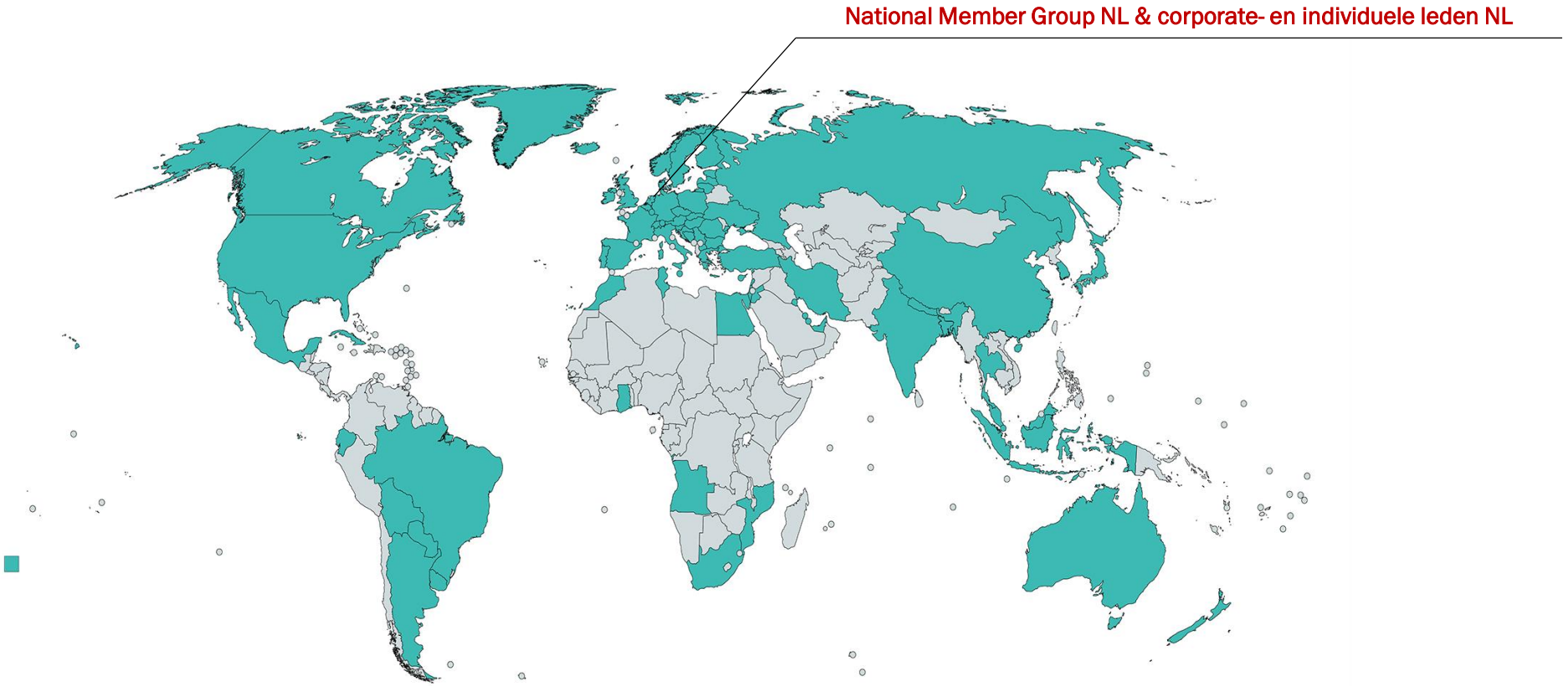
DR. IR. A.J. BIGAJ-VAN VLIET

Inhoud

- **Waroom International Federation for Structural Concrete (fib) ?**
  - Missie
  - Werkwijze
  - Internationale samenwerking in werkgroepen
  - fib technical reports, state-of-the-art reports, textbooks , manuals or guides, recommendations, **Model Codes**
- **Aspiratie en uitdaging van fib -> Model Code 2020**
  - Highlights of Model Code 2020
    - Veiligheidsfilosofie bij ontwerp en toetsing
    - Prestatiebeoordeling bestande constructies (met schade)
    - Gebruik van testen en monitoren voor bestande kunstwerken
    - Gebruik van NLFEA
- **Participate NL in fib -> *"what is in it for me"***

International Federation for Structural Concrete (fib)

- not-for-profit association
- gevormd door 42 nationale *fib* ledengroepen en ongeveer 1000 corporate- en individuele leden
- gevormd in 1998 door de fusie van het Euro-International Committee for Concrete (CEB, sinds 1953) en de International Federation for Pre-stressing (FIP, sinds 1952)



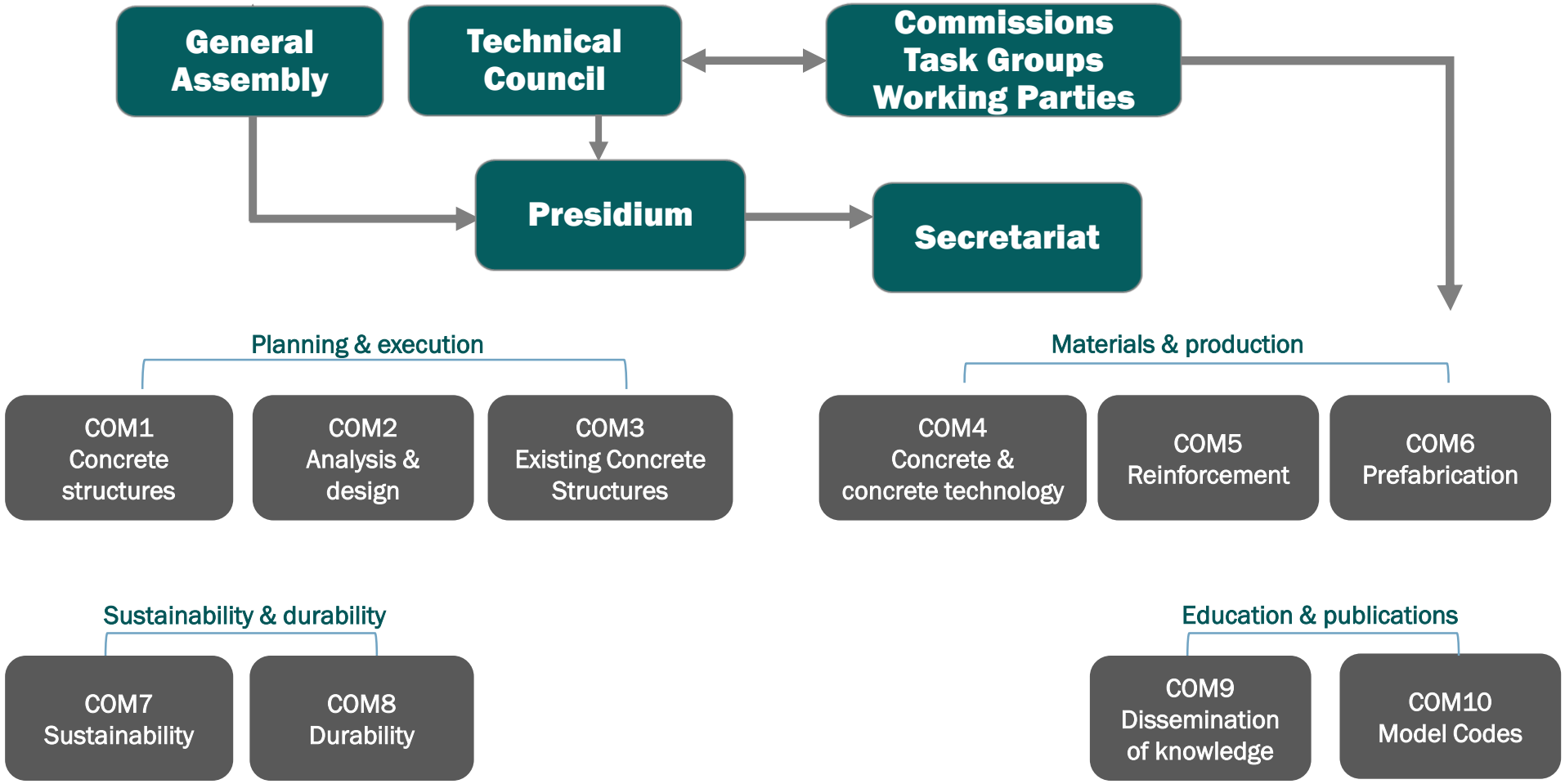
International Federation for Structural Concrete (fib)

"To develop at an international level the study of scientific and practical matters capable of advancing the technical, economic, aesthetic and environmental performance of concrete construction."

Statuten van *fib*

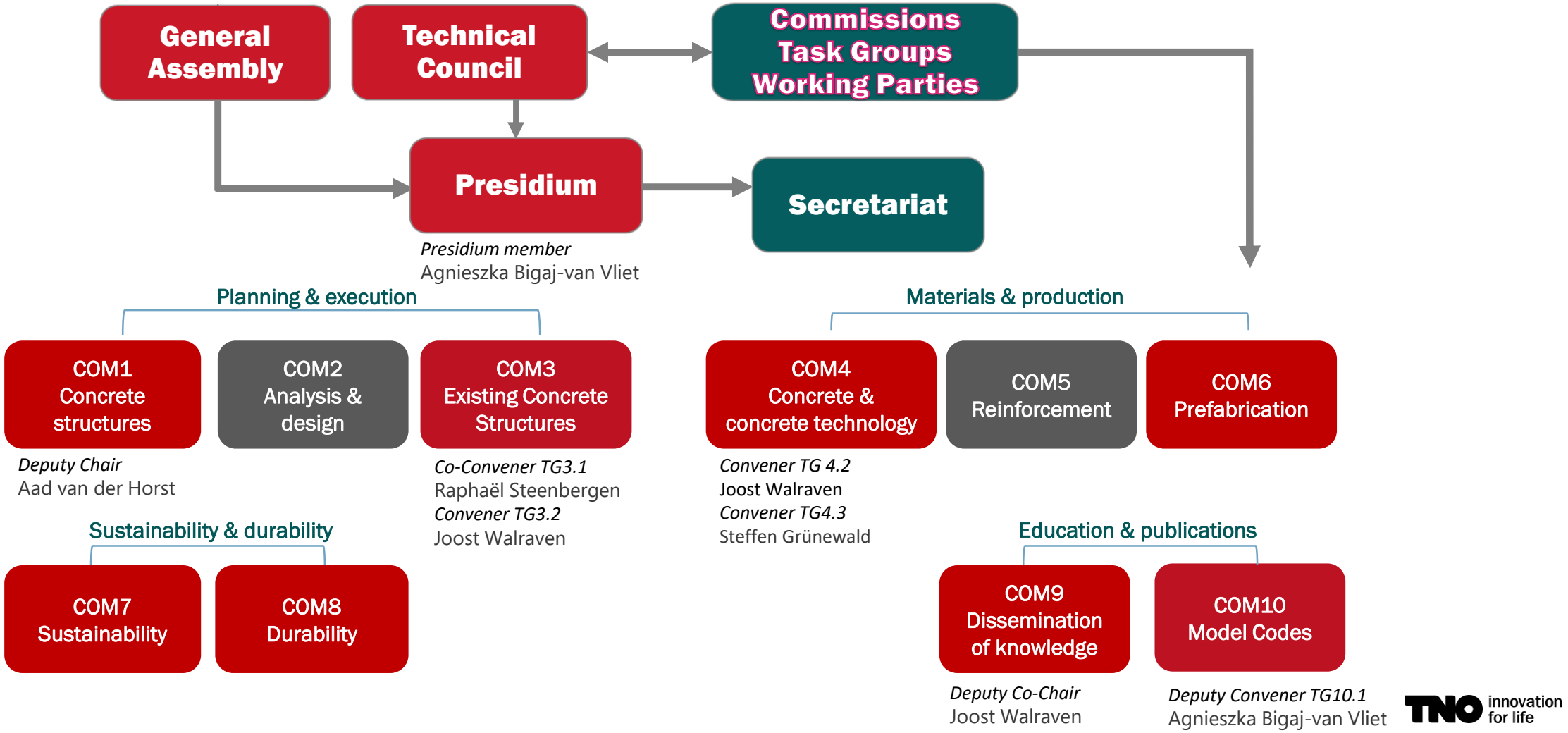
International Federation for Structural Concrete (fib)

- Werkwijze



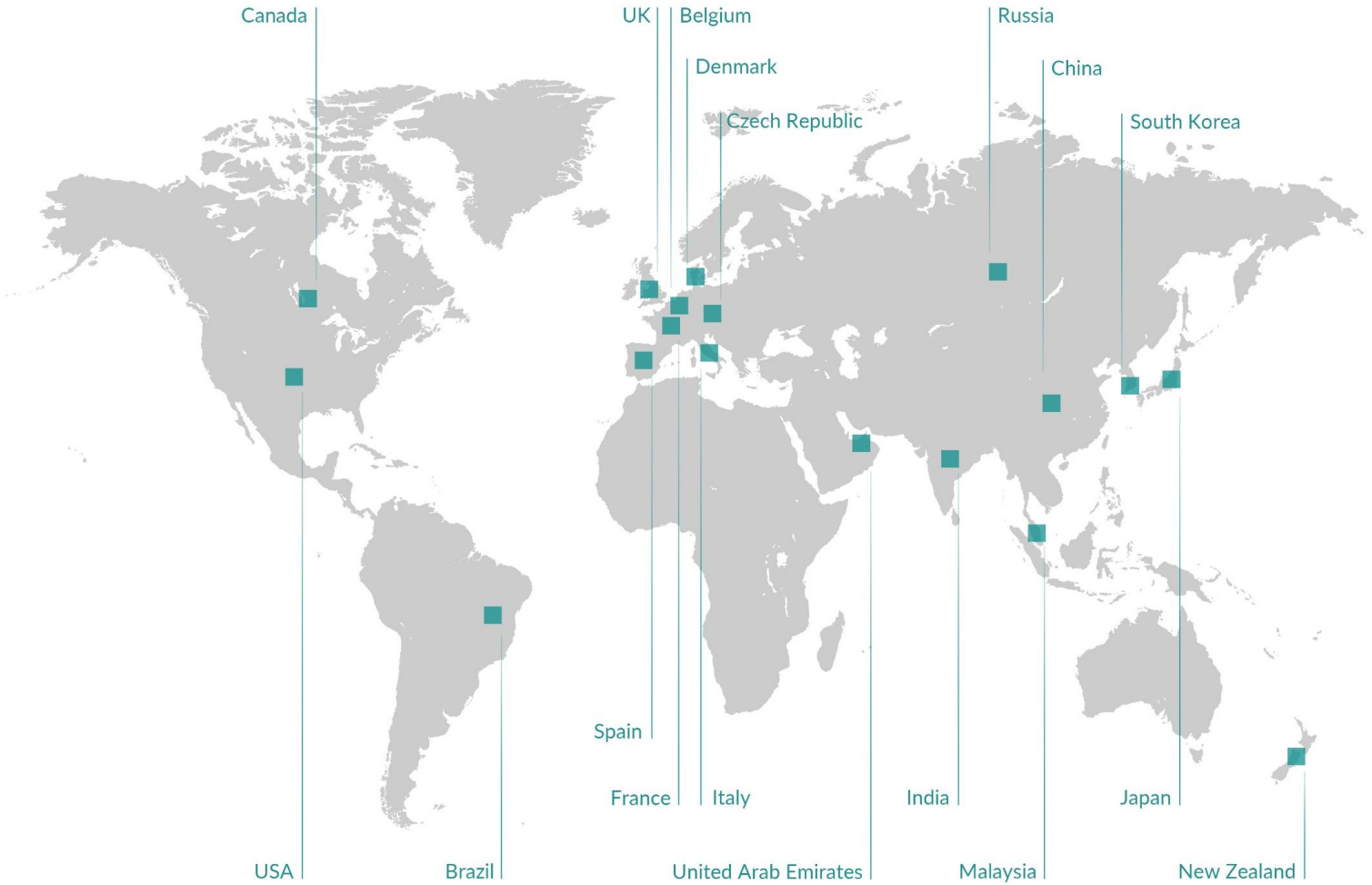
International Federation for Structural Concrete (fib)

- Werkwijze incl. participatie NL



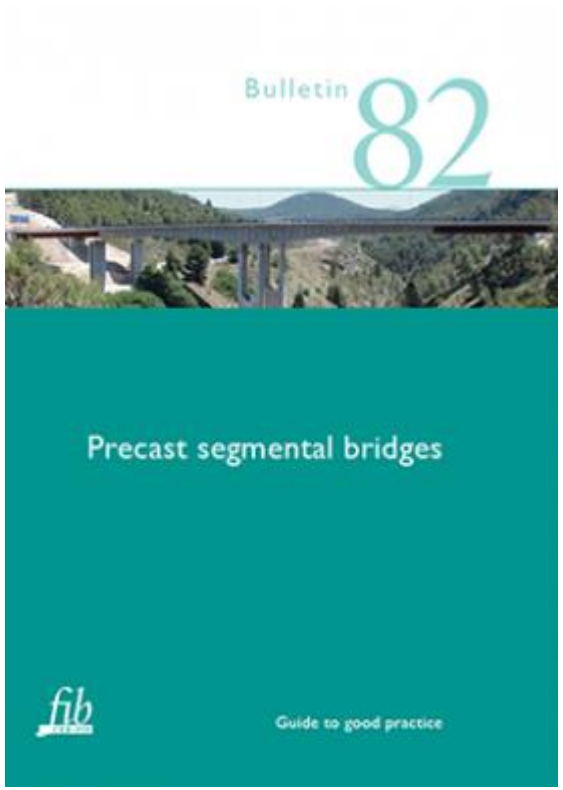
International Federation for Structural Concrete (fib)

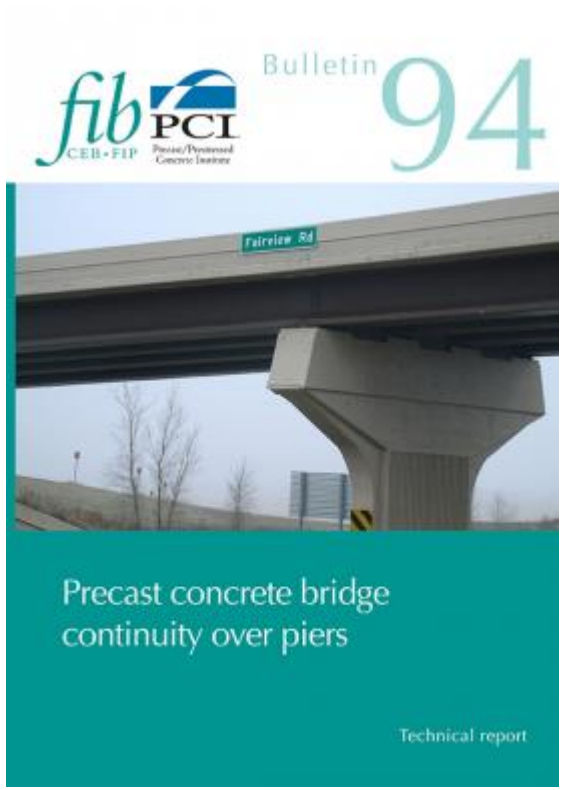
- Internationale samenwerking in **TG6.5 Precast concrete bridges**

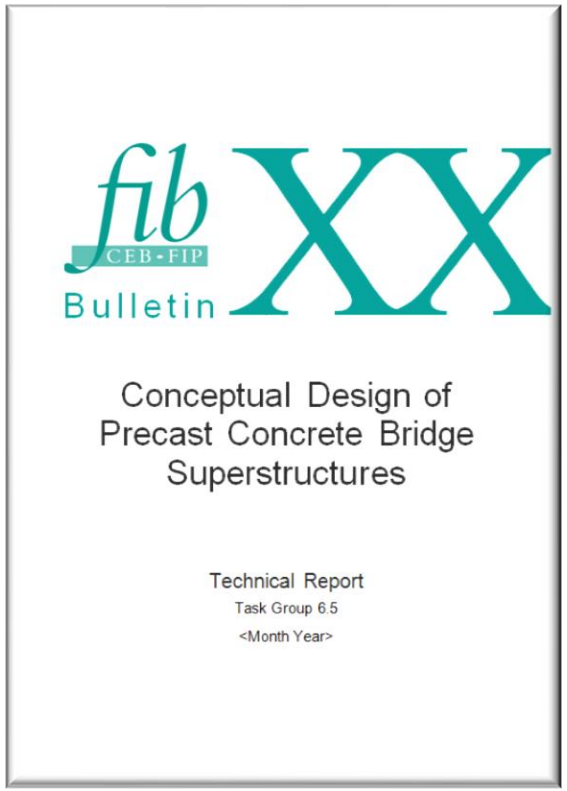


International Federation for Structural Concrete (fib)

- Internationale samenwerking in **TG6.5 Precast concrete bridges**

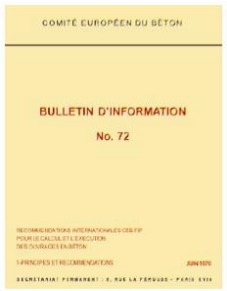




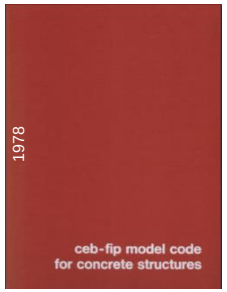


International Federation for Structural Concrete (fib)

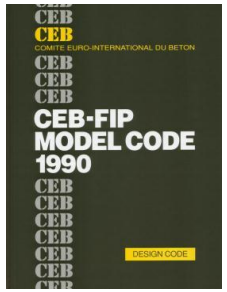
- *fib* technical reports, state-of-the-art reports, textbooks , manuals or guides, recommendations, **Model Codes**



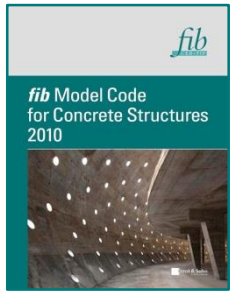
Model Code



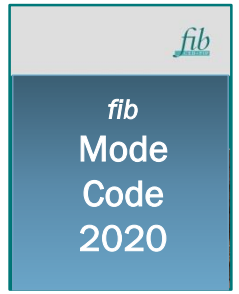
Model Code



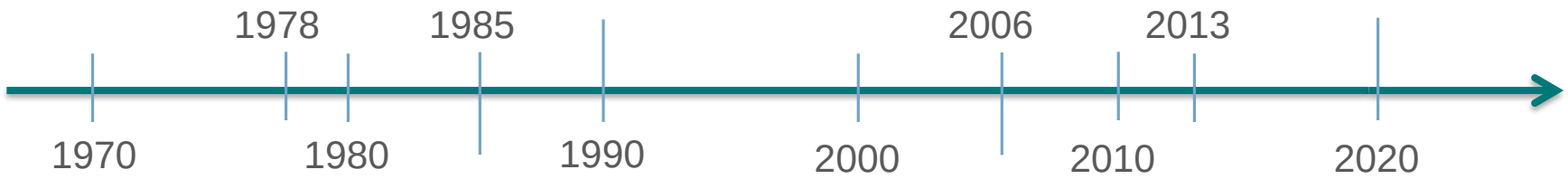
Model Code

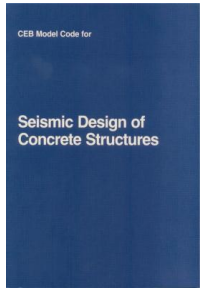


Model Code

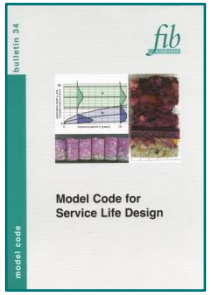


Model Code





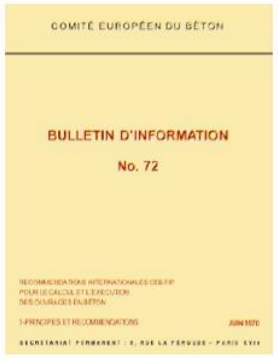
CEB Bull. 165
Seismic Design



fib Bull. 34
Service Life Design

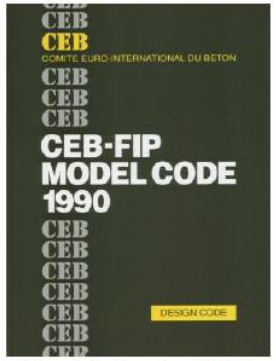
International Federation for Structural Concrete (fib)

- *fib Model Codes vs. Eurocodes*

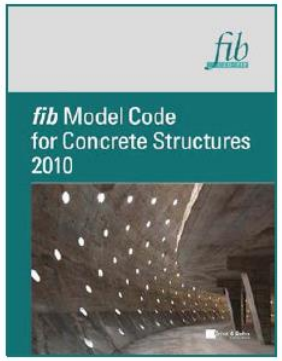


Model Code 1970

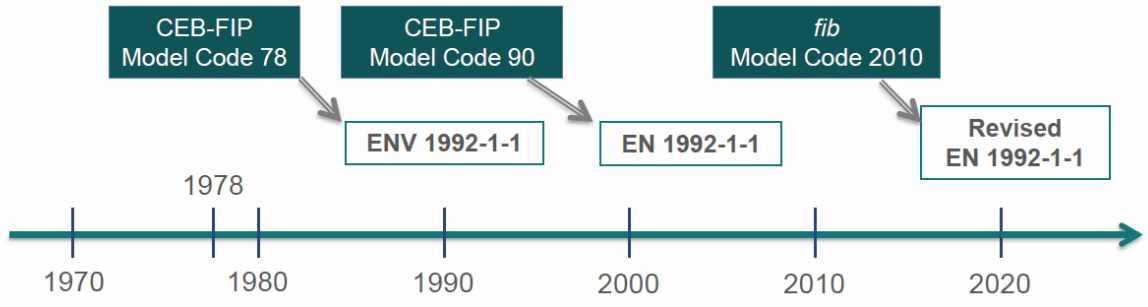
Model Code 1978



Model Code 1990



Model Code 2010



Aspiratie en uitdaging van fib Model Code 2020

- consistent aanpak voor ontwerp van nieuwe betonconstructies (incl. het wegnemen van beperkingen voor nieuwe soorten materialen) en toetsing van bestaande betonconstructies (incl. en het wegnemen van beperkingen voor oude soorten materialen en voor de verouderende van de materialen)
  - het belang van **duurzaamheid** (sustainability) en van **levenscyclusbeheer** van betonconstructies
  - het implementeren van **fundamentele principes en een veiligheidsfilosofie gebaseerd op betrouwbaarheidsconcepten**
  - het implementeren van een consistente behandeling van **veiligheid, bruikbaarheid en duurzaamheid door een prestatiegerichte benadering**

HIGHLIGHTS Model Code 2020

Consistent approach with differentiation to new and existing structures

- substantial costs of interventions on existing structures in order to increase performance levels
- remaining working life and reference period often smaller than design life of 50 years

  → adjusted target performance levels in assessment to be considered

  → adjusted reference period in assessment to be considered

- testing, inspection and monitoring can be done in order to increase Knowledge Level

  → adjusted treatment of uncertainties to be considered

- adequate structural models for existing (e.g. deteriorated) structures are needed

  → adjusted treatment of uncertainties to be considered

MAJOR CHANGES

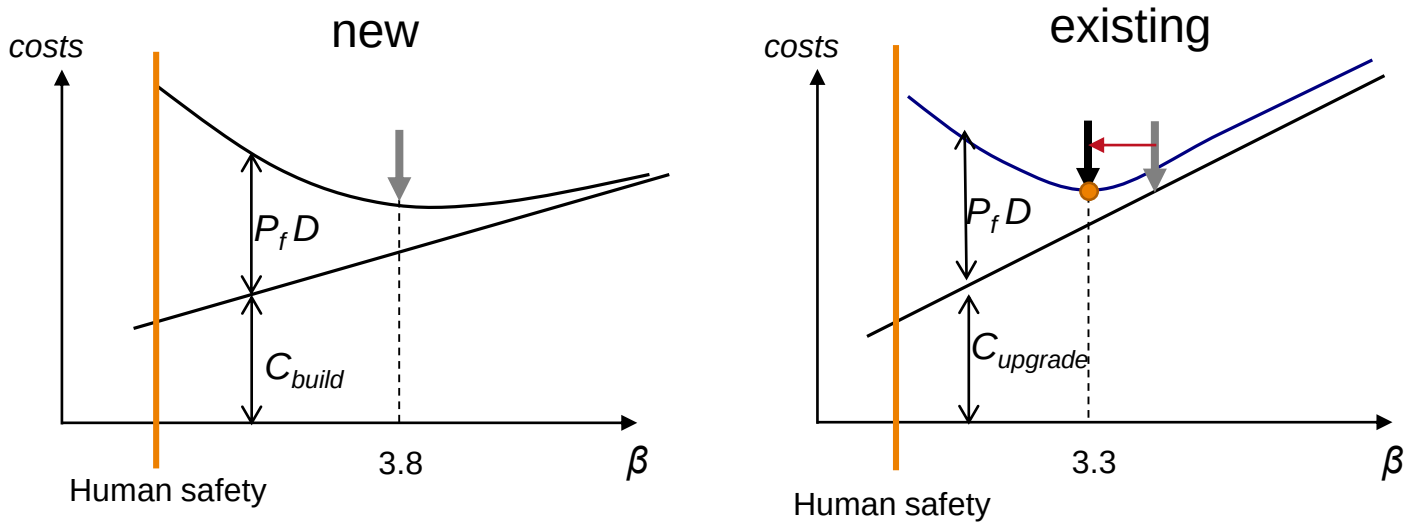
HIGHLIGHTS Model Code 2020

Consistent approach with differentiation to new and existing structures

- substantial costs of interventions on existing structures in order to increase performance levels
- remaining working life and reference period often smaller than design life of 50 years

adjusted target performance levels in assessment to be considered

adjusted reference period in assessment to be considered



HIGHLIGHTS Model Code 2020

Model Code 2020 recommends principles of probabilistic structural limit state design with a possibility for differentiating the reliability level:

- β_{new} - level indicating desired reliability for design of new structures
- β_0 - level below which the existing structure is considered unreliable and should be upgraded
- β_{up} - level indicating an optimum upgrade strategy while upgrading of existing structures

Recommended target reliability levels for structural design (ULS)			
Annual target β-values for structures to be designed, based on economic optimisation			
Relative cost of safety measure	Consequence Class		
	CC1	CC2	CC3
Large (A)	3.1	3.3	3.7
Normal (B)	3.7	**4.2**	4.4
Small (C)	4.2	4.4	4.7
Informative target reliability indices β for structures to be designed, related to a 50-year reference period			
Relative cost of safety measure	CC1	CC2	CC3
Normal (B)	3.3	**3.8**	4.3
Recommended annual target reliability levels for assessment of existing structures (ULS)			
Relative cost of safety measure	CC1	CC2	CC3
Large (A)	3.1	3.3	3.7
Recommended target reliability levels for upgrade of existing structures (ULS)			
While slightly lower values can be normally justified for β_{up}-levels in comparison to design target levels, it is common and reasonable to require the compliance with the design levels when upgrading the structure.			

HIGHLIGHTS Model Code 2020

How to deal with deterioration?

Consistent approach with differentiation to new and existing structures

- substantial costs of interventions on existing structures in order to increase performance levels
- remaining working life and reference period often smaller than design life of 50 years

adjusted target performance levels in assessment to be considered

adjusted reference period in assessment to be considered

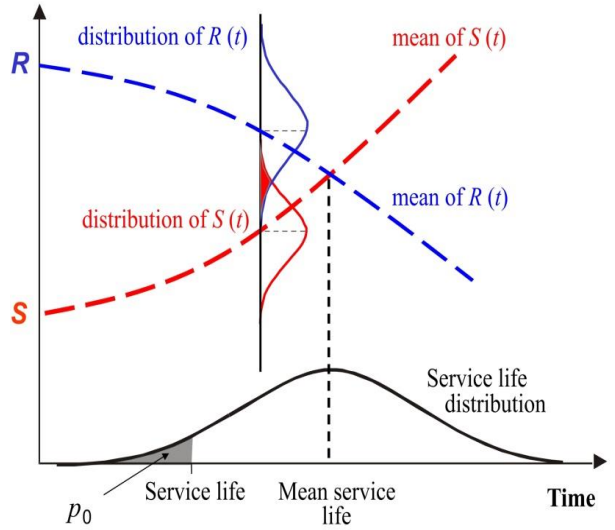
MAJOR CHANGES

HIGHLIGHTS Model Code 2020

Consistent approach with differentiation to new and existing structures

- Model Code 2020 recommends the performance-based assessment of the remaining service life:
  - ultimate limit state or serviceability limit state verification (e.g. in case damage is already existing) using annual target reliability values, corresponding to the target reliability levels.
  - verifications take basis in a coupled modelling of the initiation time and propagation time of degradation, and the present condition of the structure should take into account:
    - the uncertainties typically considered in structural reliability calculations for ULS/SLS (as done for non-degrading structures);
    - the uncertainties in relation to the initiation phase modelling;
    - the uncertainties in relation to the propagation phase modelling;
    - the uncertainties associated with monitoring, inspections and the interpretation of such data, if applied.

→ uncertainties can be reduced by updating on the basis of measurements and inspections

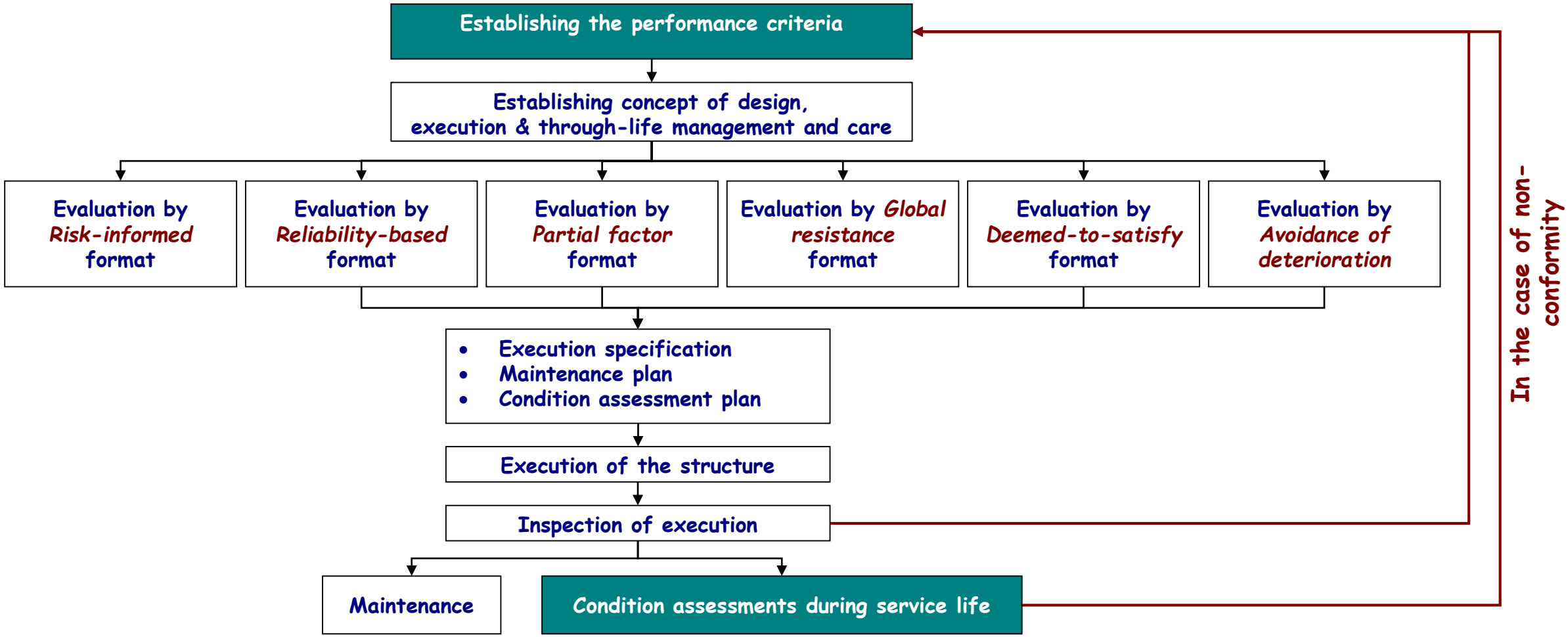


Decrease in structural resistance R(t) with time & increase in the load effect S(t) with time

Benefit of unaccounted behaviours upon structural resistance and on actual service life

HIGHLIGHTS Model Code 2020

Testing, inspection and monitoring in order to increase Knowledge Level



HIGHLIGHTS Model Code 2020

Testing, inspection and monitoring in order to increase Knowledge Level

- Model Code 2020 recommends verification assisted by testing, inspection and monitoring with due consideration of :
  - Value of information
  - Extent of surveys, testing and monitoring activities
  - Tools and techniques for surveys and monitoring
  - General flow of condition survey process
  - Data evaluation and statistical analysis of the results
  - Updating of performance prediction
    - Consideration of information from (e.g. condition) survey in quantifying governing uncertainties
    - Consideration of past performance as evidence of suitability for future performance
    - Consideration of proof loading of structures as means of conformity evaluation

MAJOR CHANGES

HIGHLIGHTS Model Code 2020

Testing, inspection and monitoring in order to increase Knowledge Level

- Verification by proof loading to be included in MC2020
  - performed to check the ability of the structure to carry a specified variable load (e.g. design loads given in the codes)
  - use of results of proof load tests in reliability-based approach to safety assessment:
    - updating of uncertainty on the resistance of the structure based on attained proof load level
    - updating of failure probability

$$P(F|I) = \frac{P(F \cap I)}{P(I)}$$

structural failure

survival of proof load test

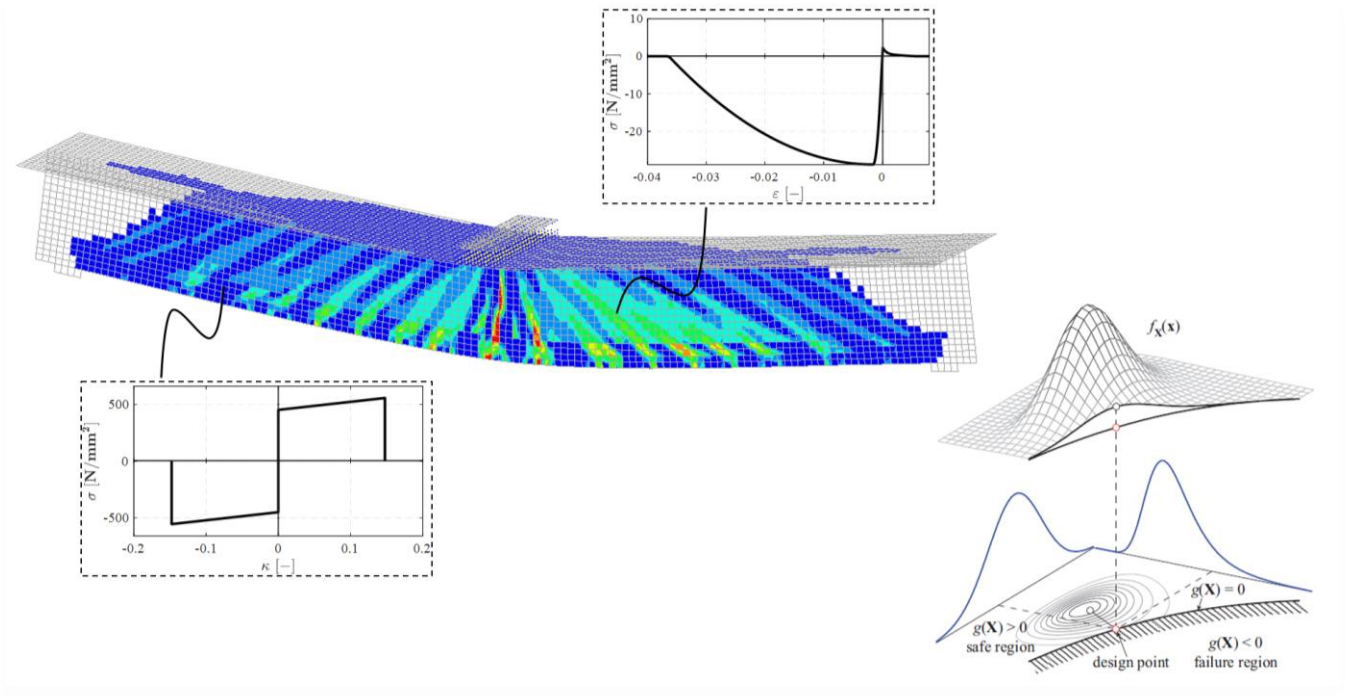
  - Ongoing work:
    - loading procedure & stop-criteria
    - definition of target proof load level depending on residual service life, current and future deterioration, etc.
    - implementation of proof loading in semi-probabilistic safety assessment as a function of attained proof load level

HIGHLIGHTS Model Code 2020

Consistent approach with differentiation to new and existing structures

- adequate structural models for existing (e.g. deteriorated) structures are needed

  → adjusted treatment of uncertainties to be considered



MAJOR CHANGES

Verification assisted by NLFEA to be included in MC2020

HIGHLIGHTS Model Code 2020

Verification assisted by NLFEA to be included in MC2020

- Model Code 2020 recommends verification assisted by NLFEA analysis with due consideration of the need of performing NLFEA :
  - areas of NLFEA for concrete structures are those where simplified analytical models fail to accurately predict structural resistances, e.g. where non-linear behaviour related to material properties and/or geometry significantly affects structural reliability or where load effects are difficult to assess due to interaction of structural members or dynamic nature of the phenomenon
  - Major challenges :
    - Adequacy of estimating the resistance with NLFEA calculations
    - Formulating safety formats for compliance check
      - Modelling uncertainties to be used in NLFEA based reliability analyses
      - Treatment of multiple failure modes
    - Extending scope of application: static and non-static (seismic, dynamic) conditions, analysis of damaged structures, accounting for progressive deterioration processes

HIGHLIGHTS Model Code 2020

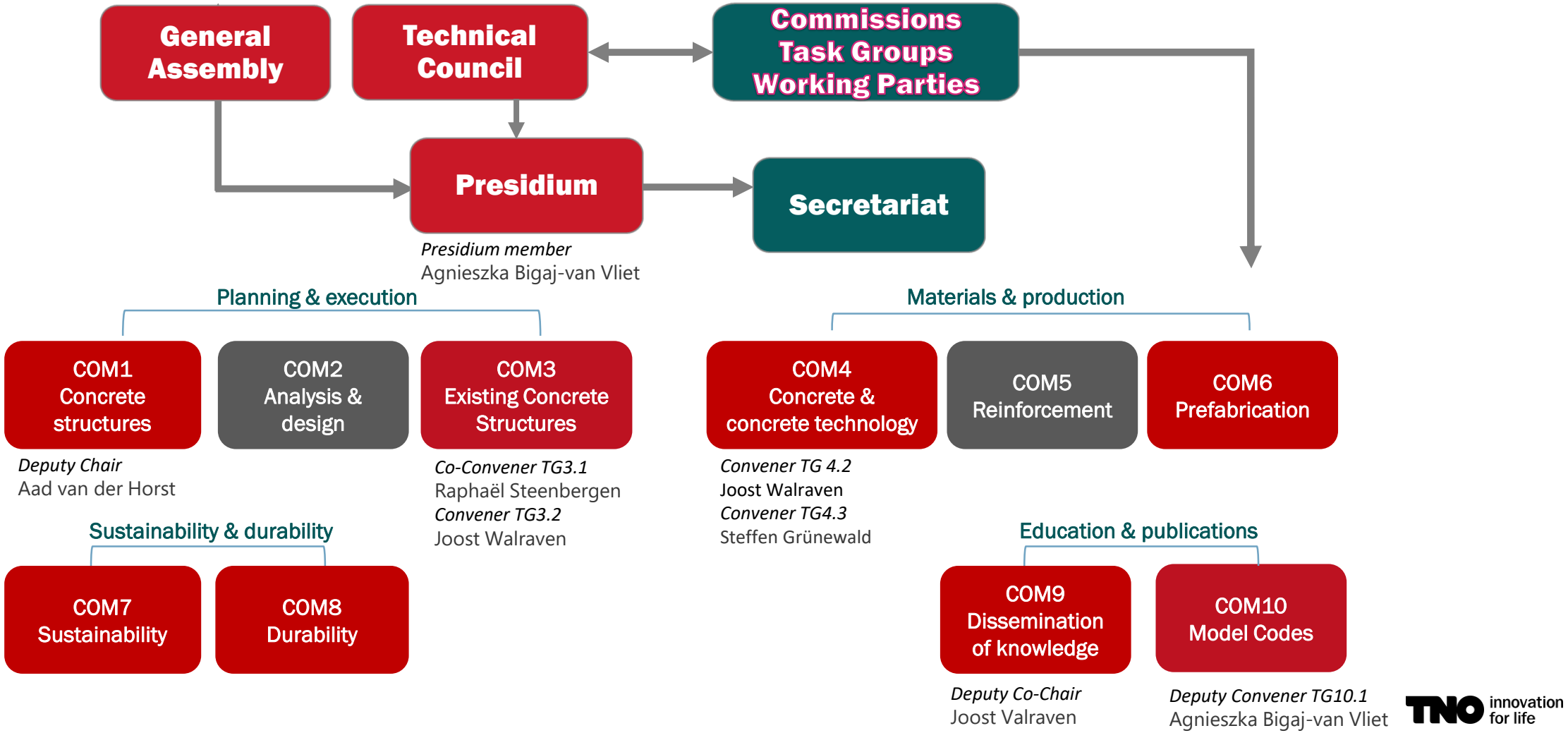
Verification assisted by NLFEA to be included in MC2020

Safety formats for estimating the resistance with NLFEA.	
I: Partial Factors Method	$R_{\mathrm{d}} = \dfrac{R_{\mathrm{NLFEA}}\left(x_{\mathrm{d,NLFEA}}\right)}{\gamma_{\mathrm{Rd}}}$
II: Global Factor Method	$R_{\mathrm{d}} = \dfrac{R_{\mathrm{NLFEA,m}}}{\gamma_{\mathrm{R}}\gamma_{\mathrm{Rd}}}$
III: Sampling-based Method	$P(\theta R_{\mathrm{NLFEA}}(\boldsymbol{x}) \leq R_{\mathrm{d}}) = \Phi(-\alpha_{\mathrm{R}}\beta)$

The modelling uncertainty, which represents the accuracy of the selected solution strategy in predicting the capacity, should be properly accounted for before conclusions are drawn based on the analysis results

* for I & II, the partial factor for modelling uncertainty (γ_{Rd}) should be appropriately assessed or updated.

Participatie NL in *fib*



Participatie NL in *fib* : kansen

NIEUWE ACTIVITEITEN VAN *fib*

***fib* technical activities**	**Status 2020**
COMMISSION 1 – Concrete Structures	
TG1.1 - Bridges	
WP1.1.6 - **Design Loads for long span bridges**	**NEW WP**
WP1.2.1 - Floating concrete structures	**Bullletin 91, Floating concrete structures,** fib state-of the-art report, (2019)
WP1.2.2 - Submerged tube bridges	**Bulletin 96, Guidelines for submerged floating tube tunnels,** guide to good practice, (2020)
WP1.4.4 - **Assemblies and fastenings in tunnel linings**	**NEW WP**
TG1.5 - **Structural sustainability in conceptual design**	**FUTURE-ORIENTED WP**
TG1.8 - Concrete industrial floors	**Bulletin xx, Industrial Floors,** fib guide to good practice, (-> 2021)
COMMISSION 2 – Analysis and Design	
TG2.1 - Serviceability models	**Bullletin 92, Serviceability Limit State of Concrete Structures,** fib technical Report, (2019)
WP2.4.1 – **Numerical modelling of FRC**	**NEW WP**
TG2.5 - Bond and material models	**Bulletin xx, Bond in Concrete,** fib technical Report, (-> 2021)
TG2.6 - Composite steel-concrete construction	**Bulletin xx, The basis of structural behaviour of steel-concrete constructions,** technical report, (-> 2021)
TG2.11 - **Structures made by digital fabrication**	**NEW WP**

Participatie NL in *fib* : kansen

NIEUWE ACTIVITEITEN VAN *fib*

fib technical activities	Status 2020
COMMISSION 3 – Existing Concrete Structures	
TG3.2 - **Modeling of structural performance of existing concrete structures**	**Bulletin xx, Modeling of structural performance of existing concrete structures,** fib SotA report, **(->** 2020) **NEW ToR**
TG3.3 - Assessment /evaluation and decision-making procedures for the through-life management of existing concrete structures	
TG3.4 - Selection and implementation of interventions / through-life management activities and measures	
TG3.5 - Forensic engineering	**NEW TG**
COMMISSION 4 – Concrete & Concrete Technology	
TG4.1 - Fibre-reinforced concrete	
TG4.2 - Ultra high-performance fibre-reinforced concrete	**Bulletin 95, Fibre Reinforced Concrete: From Design to Structural Applications,** fib technical report (2020)
TG4.5 – **Time-dependent behaviour of concrete**	**NEW TG**
TG4.6 - **Constitutive laws for concretes with supplementary cementitious materials**	**NEW / FUTURE-ORIENTED WP**
TG4.7 – **Recycled aggregate concrete**	**NEW TG**
TG4.8 - Low carbon concrete structures	**NEW TG**

Participatie NL in *fib* : kansen

NIEUWE ACTIVITEITEN VAN *fib*

***fib* technical activities**	**Status 2020**
COMMISSION 5 - Reinforcements	
TG5.1 - FRP Reinforcement for concrete structures	**Bulletin 90, Externally applied FRP reinforcement for concrete structures,** fib technical Report (2019)
WP5.1.1 – Prestressing with FRP	**NEW WP**
TG5.5 - Cables for cable-supported bridges	**Bulletin 89 Acceptance of stay cable systems using prestressing steels,** (fib guide to good practice), (2019)
TG5.6 - Behaviour under cryogenic conditions	**Bulletin xx, Acceptance of post-tensiong systems for cryogenic applications,** guide to good practice, (-> 2021)
TG5.10 – Inspection and monitoring of reinforced/prestressed concrete structures	**NEW TG**
TG5.11 – Polymer-duct system for internal bonded post-tensioning	**NEW TG**
COMMISSION 6 - Prefabrication	
TG6.3 - Sustainability of structures with precast elements	**Bulletin 88, Sustainability of precast structures,** fib SotA report, (2018)
TG6.5 - Precast concrete bridges	**Bulletin 94, Precast concrete bridge continuity over piers,** fib technical report (2020)

Participatie NL in *fib* : kansen

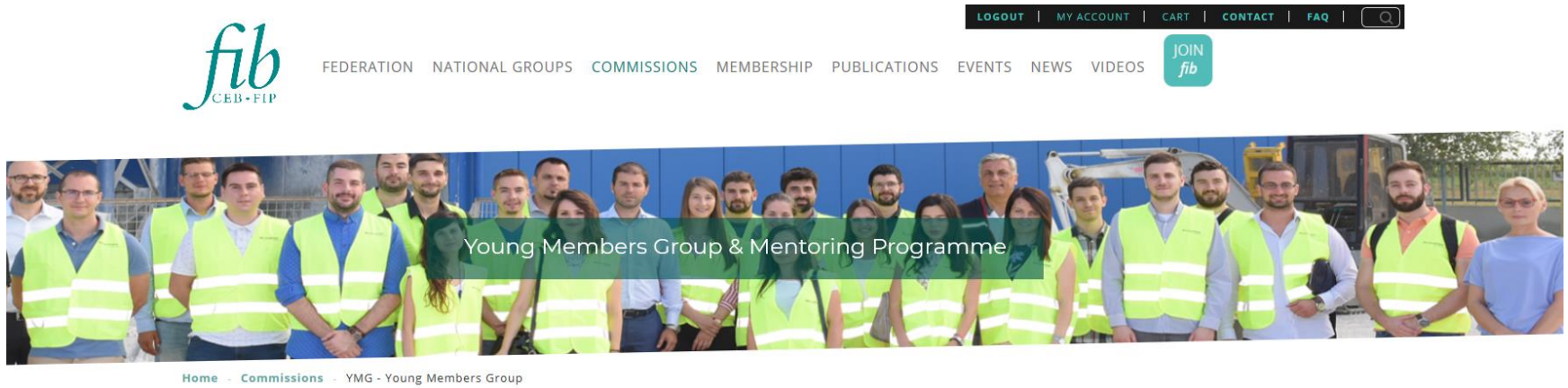
NIEUWE ACTIVITEITEN VAN *fib*

***fib* technical activities**	**Status 2020**
COMMISSION 7 - Sustainability	**FUTURE ORIENTED**
TG7.1 - Sustainable Concrete - general framework	
TG7.3 - Concrete made with recycled materials – Life cycle perspective	
TG7.4 - Sustainable civil structures	
TG7.5 - Environmental product declarations (EPD) and equivalent performance of concrete	
TG7.6 - Resilient structures	
TG7.7 - Sustainable concrete masonry components and structures	
COMMISSION 8 - Durability	
TG8.2 - Birth and re-birth certificates & through-life management aspects	**Bulletin 93, Birth Certificate and Through-Life, Management Documentation**, fib technical report (2020)
TG8.3 - Operational document to support Service Life Design	
TG8.4 - Life cycle cost (LCC) - Design life and/or replacement cycle	

Participatie NL in *fib* : keuzes

DE KANS OP TOEGANG TOT EN BEÏNVLOEDEN VAN INTERNATIONALE (BETON)KENNIS

- participatie in National member Group ?
- actieve deelnamen aan fib TG & WP ?
- agenderen van onderwerpen bij fib via NMG, TC, fib Commissies?
- invited fib lectures i.r.t. focus stufib commissies ?
- aankondiging fib publicaties ?
- YMG ?



BEDANKT VOOR
UW AANDACHT

TNO innovation for life