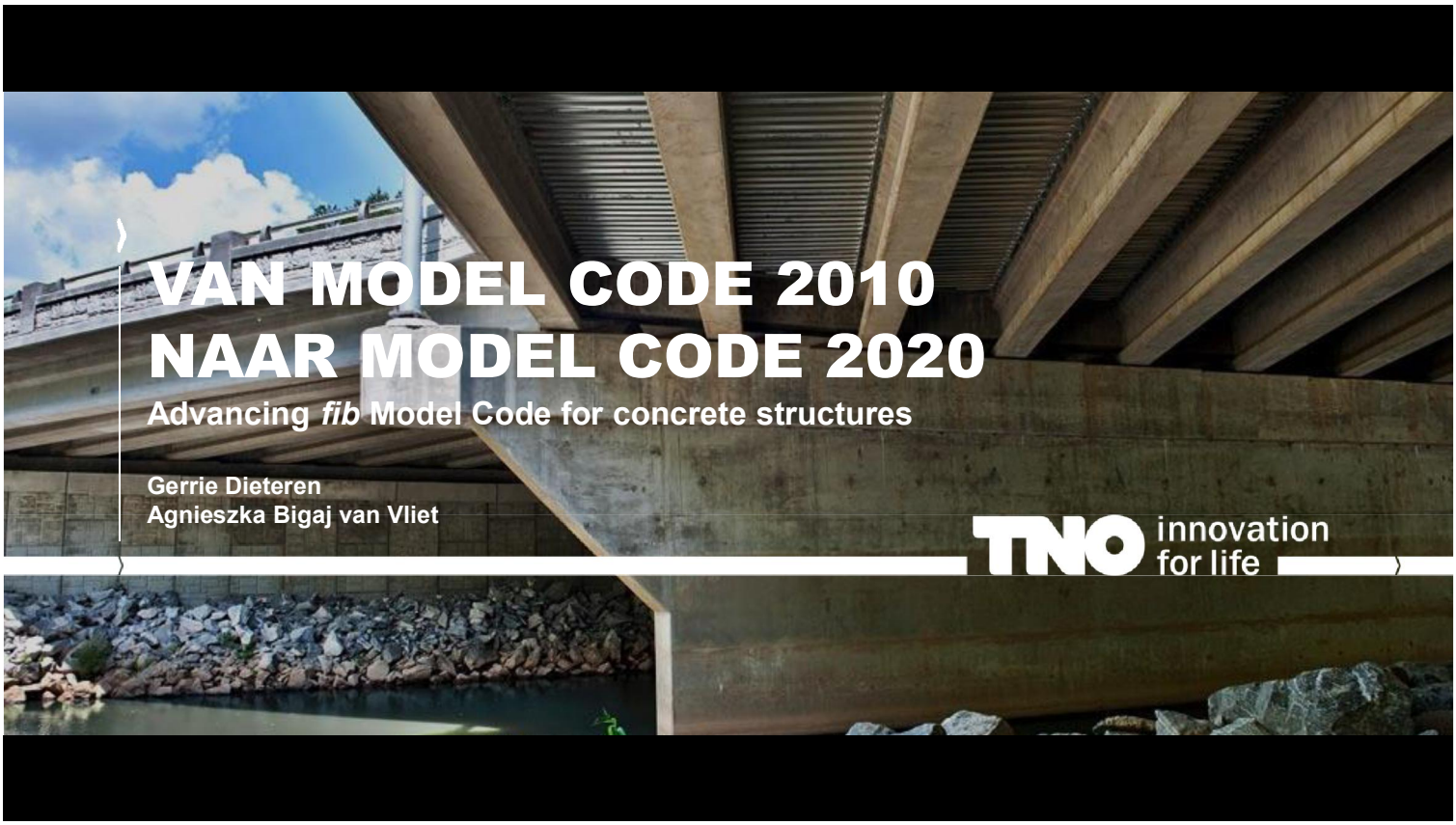
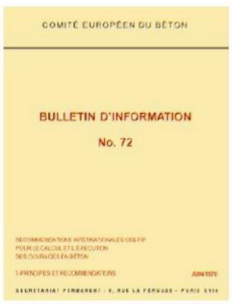


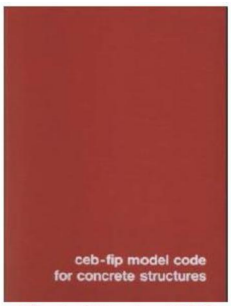
CONTENTS

- Achievements & experience with MC2010
- Need for Model Code advancement
- Proposed updates and extensions for MC2020
    - General principles
    - Scope extension
- Organization framework & timeline for MC2020

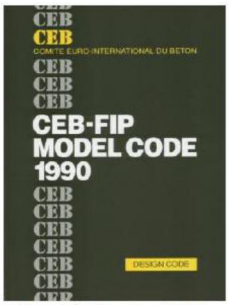
EVOLUTION OF MODEL CODES FOR STRUCTURAL CONCRETE



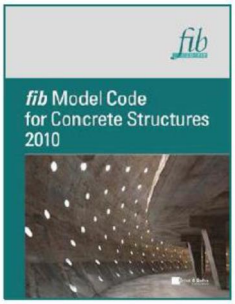
Model Code 1970



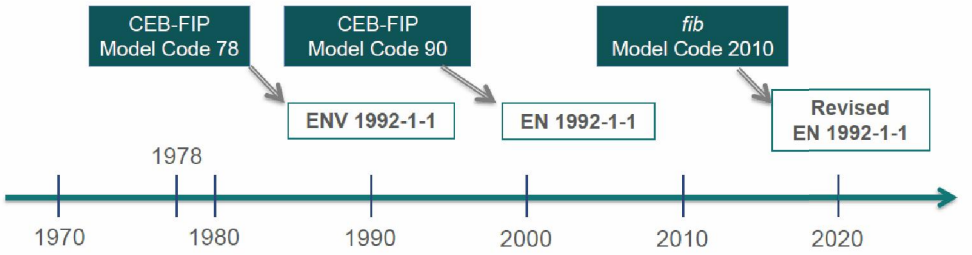
Model Code 1978



Model Code 1990



Model Code 2010

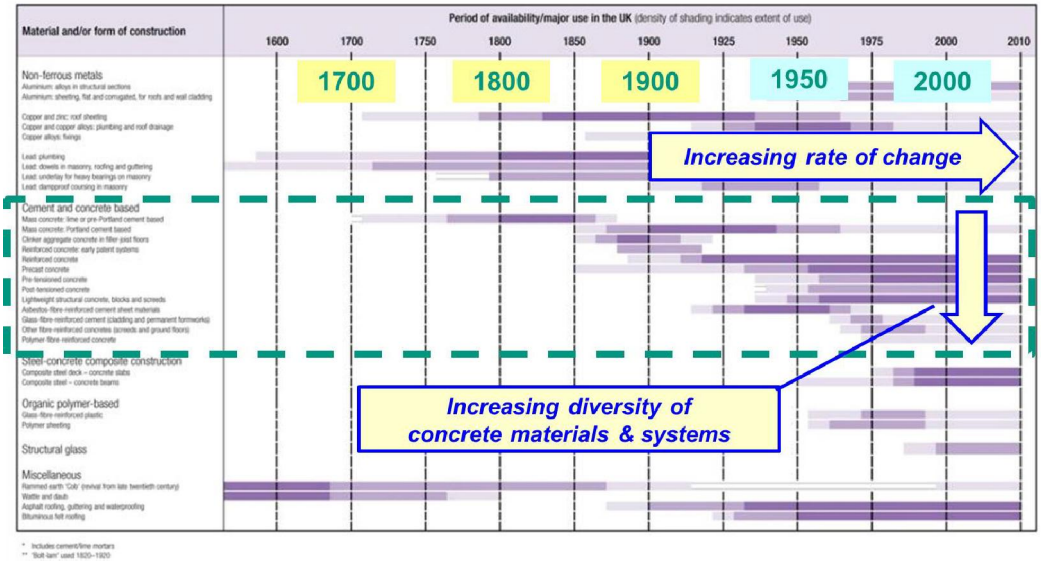


LOOKING BACK AT MC2010

11th fib General Assembly voting on Model Code 2010, Lausanne, 29 October 2011

LOOKING BACK AT MC2010

› **Implications of improved materials and forms of construction**



TNO innovation for life

LOOKING BACK AT MC2010

› **Implications of improved materials and forms of construction**

- High performance materials offer amazing chances, but need new standards
- Concrete strength until C120 in daily use
- Defined performance design asks for uncoupling concrete strength and concrete properties

Test of prestressed slab, USA, 1954

Test of UHPC slab, The Netherlands, 2015

LOOKING BACK AT MC2010

- **Implication of dealing with old types of concrete and old forms of construction**
  - Knowledge of old materials is decreasing
  - Insight in deterioration processes is required
  - Upgrading, repairing, refurbishment, retrofitting & strengthening are becoming daily business
  - Understanding of interaction between old and new materials is incomplete
  - Reliable determination of structural performance of existing structures is needed

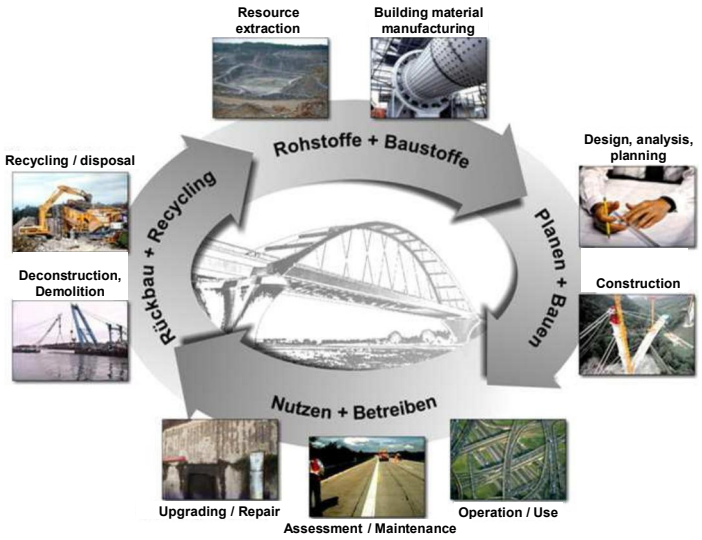
Impact damage

Freeze-thaw damage

Fire damage

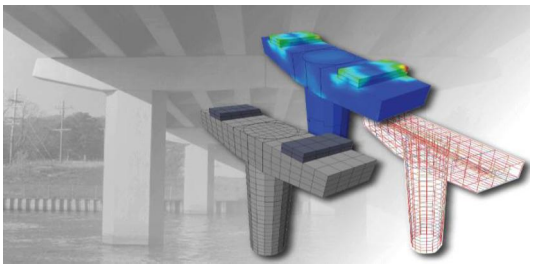
LOOKING BACK AT MC2010

- Recognition of User Needs & Life-Cycle Perspective
  - New world-wide challenge
    - Dealing with increasing need for mobility
    - Dealing with aging of society
    - Dealing with limited resources
    - Dealing with the CO2 emission problem
- Developing integral design concepts including sustainability by smart (conceptual) design



LOOKING BACK AT MC2010

- **Enabling use and benefiting from new technologies:**
  - FEM: powerful computers and numerical programs
    - For structures with special characteristics (size, complications, advanced shapes, unknown boundary conditions) reliable numerical analyses can provide valuable information on structural behavior, safety and remaining service life
  - SHM: monitoring with advanced sensor techniques
    - Structural Health Monitoring enables to assess reliable data on the real conditions and behavior of structures, and may enable reduction of uncertainties in the assessment and prediction of the performance of the structures



Bridge support NL-FEM analysis (DIANA)

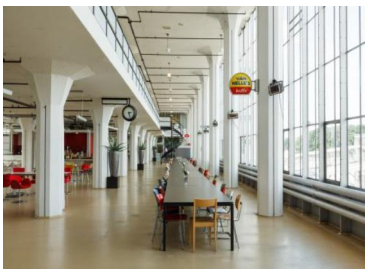
Corrosion measuring & monitoring systems

GENERAL PRINCIPLES OF MC2010

- Design of concrete structures should be aimed at creating a **reliable** structure with required **durability**, i.e. structure that meets specified demands for **safety** and **serviceability** for a defined number of years in a **sustainable** way
  - Even though concrete structures have a limited service life, it can considerably be extended by:
    - good (conceptual) design
    - good (conceptual) re-design based on objective assessment
    - adequate threw-life management

1930

Van Nelle factory
Rotterdam, The Netherlands

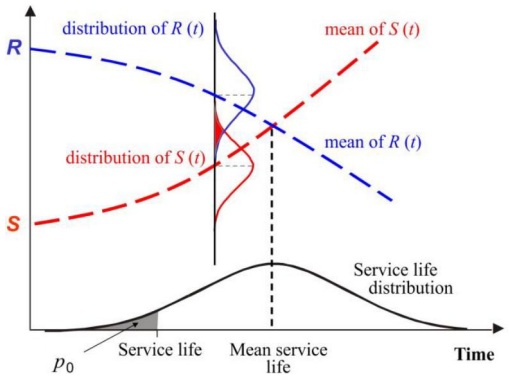


2016

GENERAL PRINCIPLES OF MC2010

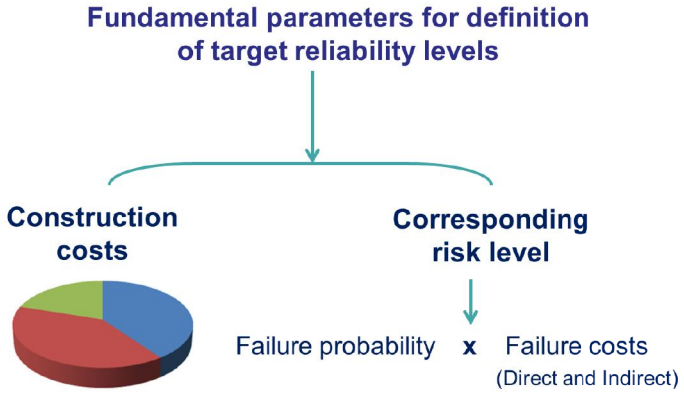
Safety, serviceability, durability and sustainability as design criteria

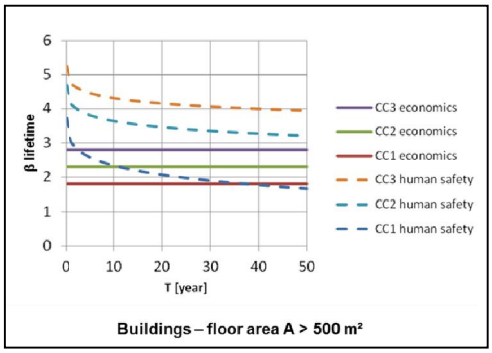
- **Performance-based approach**
  - In the context of the performance-based design of structures, reliability refers to the ability of a structure or structural member to fulfil the performance requirements during the service life for which it has been designed at a required probability level.
- **Limit state concept**
  - To represent the transition between the desired state and the adverse state the concept of limit state is adopted:
    - reliability differentiation for new and existing structures
    - application of reliability concepts for/in service life design
    - introduction of reliability concepts for/in numerical analysis
- **Reliability-based safety philosophy**
  - Reliability concepts shall cover at the same time **new and existing structures**



GENERAL PRINCIPLES OF MC2010

› **Reliability based safety philosophy**





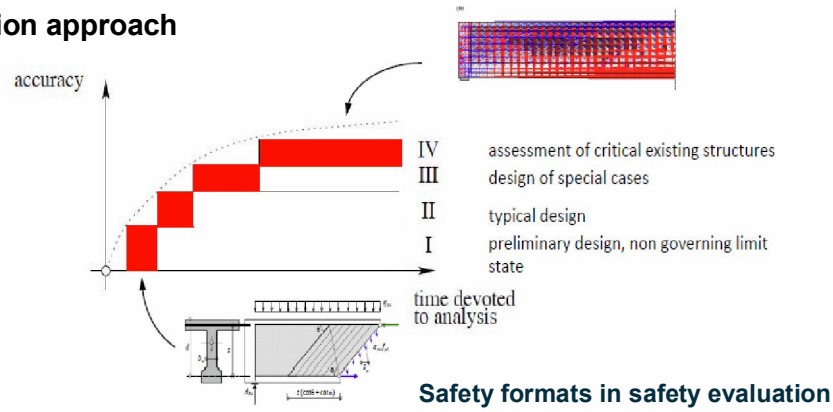
GENERAL PRINCIPLES OF MC2010

Performance-based design and assessment

- **Verification procedures**
  - Procedures should demonstrate that no violation of the limit state criteria takes place during the entire (residual) service life.
  - Verification shall be done by scientifically based **descriptional models**, which are provided at different **level of approximations,** and considering **leven of knowledge.**
- **Descriptional models**
  - Models for describing the behavior and the structural resistance shall be derived on physical basis. Empiricism has been largely removed, which is in favor of a clear definition of the limits of applicability.
  - The models should, however, not only include the relevant parameters, but reflect the stochastic character of proceses described.
- **Level of Approximation approach**
  - The level op Approximation approach is considered to be a major step ahead:
  - A basic principle of this approach is that the highest LoA models represent the performance with the highest accuracy and the lower LoA models are consequent simplifications of this representation.
- **Level of Knowledge**
  - Due considertaion of the level of knowledge and consistent tratment of parameter and model associated is needed.

GENERAL PRINCIPLES OF MC2010

Level of Approximation approach



Levels of approximation

IV System assessment of critical existing structures & design of special cases e.g. by FEM
III In-depth elemental evaluation of existing structures & design of special cases
II Typical elemental design & assessment
I Preliminary design & assessment, non governing limit state

Safety formats in safety evaluation: Levels I to IV

I Partial factor methods
II Updating of info / reduction in uncertainty
III Full probabilistic approach
IV Full probabilistic with cost (& sustainability) optimisation

GENERAL PRINCIPLES OF MC2010

Approach to service life design used in fib Model Code

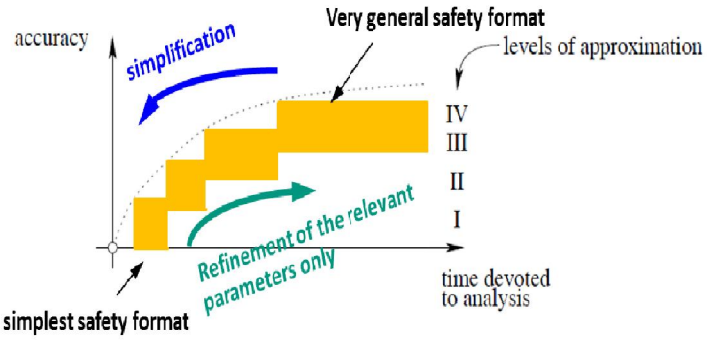
Safety formats in durability evaluation: Levels I to IV

I Avoidance of deterioration
Low likelihood of deterioration for particular limiting circumstances / concrete recipes, but not fool proof

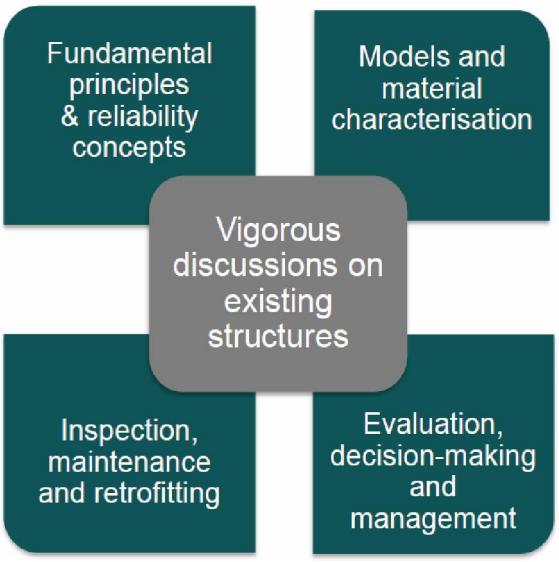
II Deemed-to-satisfy design
Tabulated approach most widely used at present

III Partial factor design
If calibrated, appropriate to standard structures

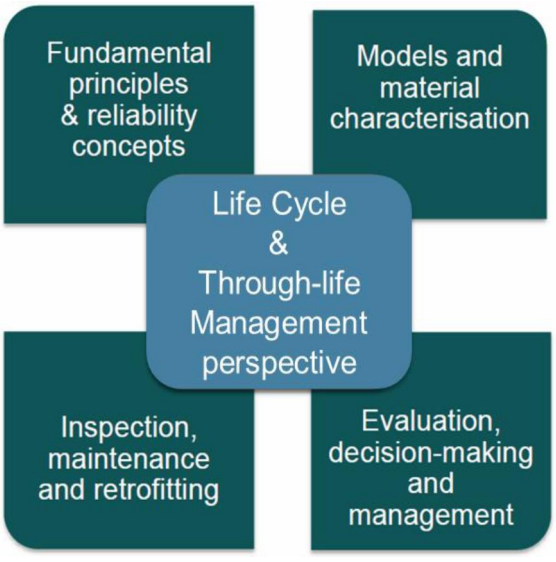
IV Full probabilistic design
Only realistic for special / monumental structures



LOOKING FORWARD AT MC2020



MC2010



MC2020

GENERAL PRINCIPLES OF MC2020

Single merged structural code for both new and existing concrete structures

- Integrated life cycle perspective with particular attention to through-life management,
- Fundamental principles and a safety philosophy based on reliability concepts,
- Implementation of performance based concept,
- Holistic treatment of structural safety, serviceability, durability and sustainability,
- Consistent approach to robustness and redundancy/resilance
- Provisions based on generalized models and level of approximation approach,
- Removing constraints for novel types of concrete and reinforcing materials and novel types of construction forms,
- Considering material degradation and accounting for progressive damage
- Full advantage of information acquired by testing and monitoring.

- Strong international (world) perspective

GENERAL PRINCIPLES OF MC2020

Safety philosophy for (new & existing) concrete structures

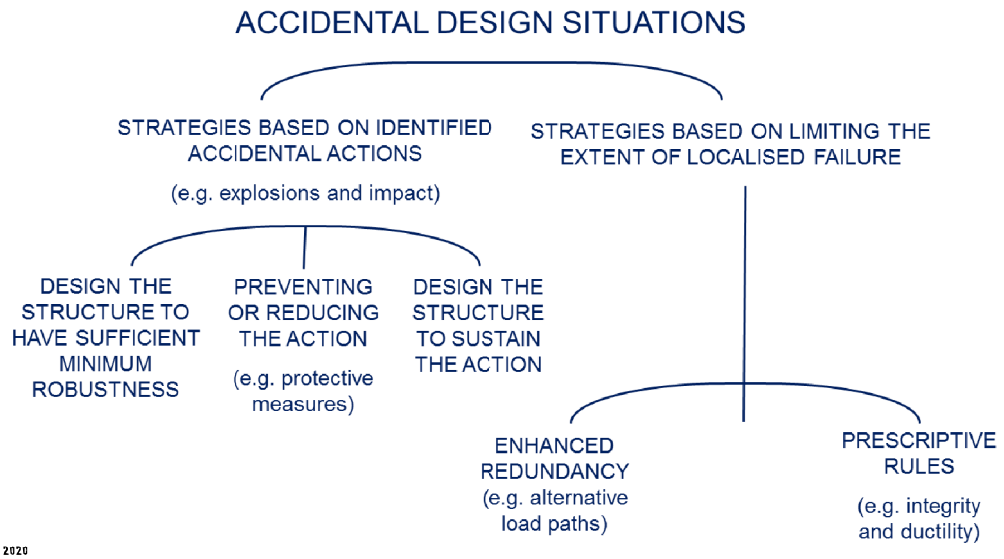
Reliability concepts shall be extended and updated to cover at the same time new and existing structures considering that:

- higher target reliability levels implies a larger cost increment in existing structures compared to new
- remaining service life is smaller for existing structures compared to design working life of new structures
- updated information on actual resistance of an existing structure can be available

The target reliability values (β) may be reduced in existing structures compared to the new ones

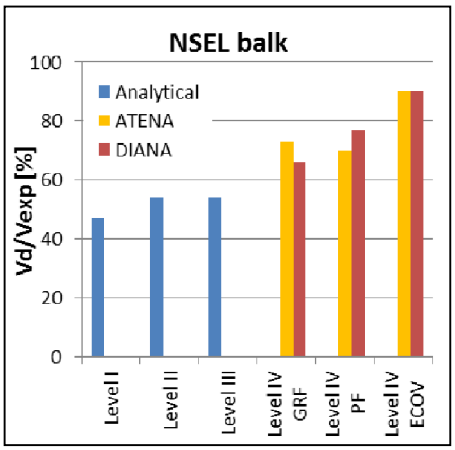
GENERAL PRINCIPLES OF MC2020

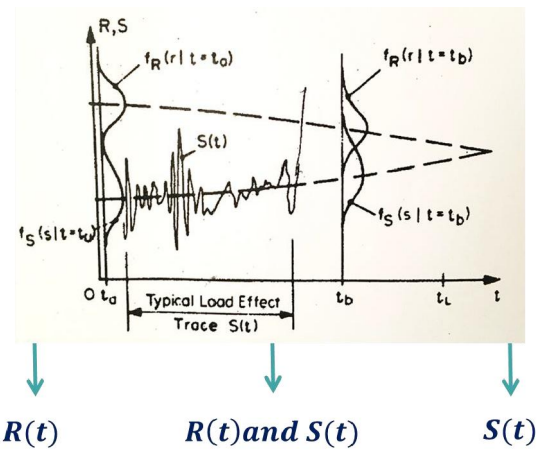
Design strategies for robustness of (existing) structures



GENERAL PRINCIPLES OF MC2020

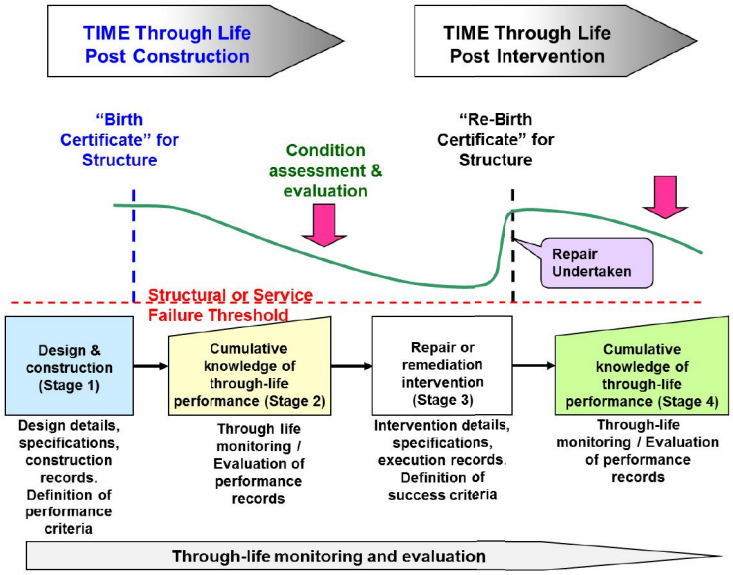
- **Time–dependent reliability analysis by modern analysis tools (FEM)**
  - Computation approaches shall enable accounting for progressive deterioration process
  - Computation approaches could be pursued for the reliability analysis of structures showing implicit limit state functions





GENERAL PRINCIPLES OF MC2020

Through-life management of (existing) structures



MC2020 CONTENTS PROPOSAL

MC2010 Part I: General	MC2020 Part I: General
1. Scope	1. Scope
2. Terminology	2. Terminology

3. Basic principles
• Performance-based approach principles
  • Performance requirements for serviceability and structural safety
  • Performance criteria for sustainability
• Life cycle quality management
	3. Basic principles of design and assessment
	• Through-life management framework
	• Sustainability perspective
	• Performance-based approach principles
	  • Levels-of-Performance approach
	  • Reliability principles incl. uncertainty treatment
	  • Levels-of-Approximation approach
	• Performance requirements for serviceability, structural safety (incl. durability & robustness implications), environmental performance & economic performance
	• Quality and Information Management
	• Life Cycle Management incl. decision-making

MC2020 CONTENTS PROPOSAL

MC2010 Part I: General	MC2020 Part I: General

4. Principles of structural design
• **Design situations, strategies and methods**
• **Safety formats**
	4. Principles and processes
	• **Design and assessment situations**
	• **Design and assessment strategies**
	• **Design and assessment methods**
	  • Limit state design principles
	  • Safety formats principles
	  • Calibration principles
	• **Safety formats**
	  • Probabilistic safety format
	  • Partial factor format
	  • Global resistance format
	  • Deemed-to-satisfy approach
	  • Design by avoidance
	• **Principles of construction**
	• **Principles of conservation**
	• **Principles of dismantlement and reuse**

MC2020 CONTENTS PROPOSAL

MC2010 Part II: Design Input Data	MC2020 Part II: Design & Assessment Input Data

5. Materials
• **Input data for contemporary materials**
  • concrete,
  • reinforcing steel,
  • prestressing steel,
  • prestressing systems,
  • non-metallic reinforcement,
  • fibres/fibre reinforced concrete
	5. Materials
	• **Input data for contemporary materials** incl.
	  • concrete,
	  • reinforcing steel,
	  • prestressing steel,
	  • prestressing systems,
	  • non-metallic reinforcement,
	  • fibres/fibre reinforced concrete,
	  • ultra high performance concrete,
	  • protective materials & systems
	• **Input data for other (alternative / old) materials**
	• **Input data for other forms of construction**
	• **Input data for material damage and deterioration**

MC2020 CONTENTS PROPOSAL

MC2010 Part II: Design Input Data	MC2020 Part II: Design & Assessment Input Data

6. Interface characteristics
• **Input data for contemporary materials**
  • bond of embedded steel reinforcement
  • bond of non-metallic reinforcement
  • concrete to concrete
  • concrete to steel
	6. Interface characteristics
	• **Input data for contemporary materials**
	  • bond of embedded steel reinforcement
	  • bond of prestressing rebars
	  • bond of embedded non-metallic reinforcement
	  • bond of externally bonded non-metallic reinforcement
	  • bond of externally bonded steel
	  • concrete to concrete
	  • concrete to steel
	• **Input data for other (alternative / old) materials**
	• **Input data for other forms of construction**
	• **Input data for material damage and deterioration**
	  • bond of corroded steel reinforcement

MC2020 CONTENTS PROPOSAL

MC2010 Part III: Design	MC2020 Part III: Design & Assessment

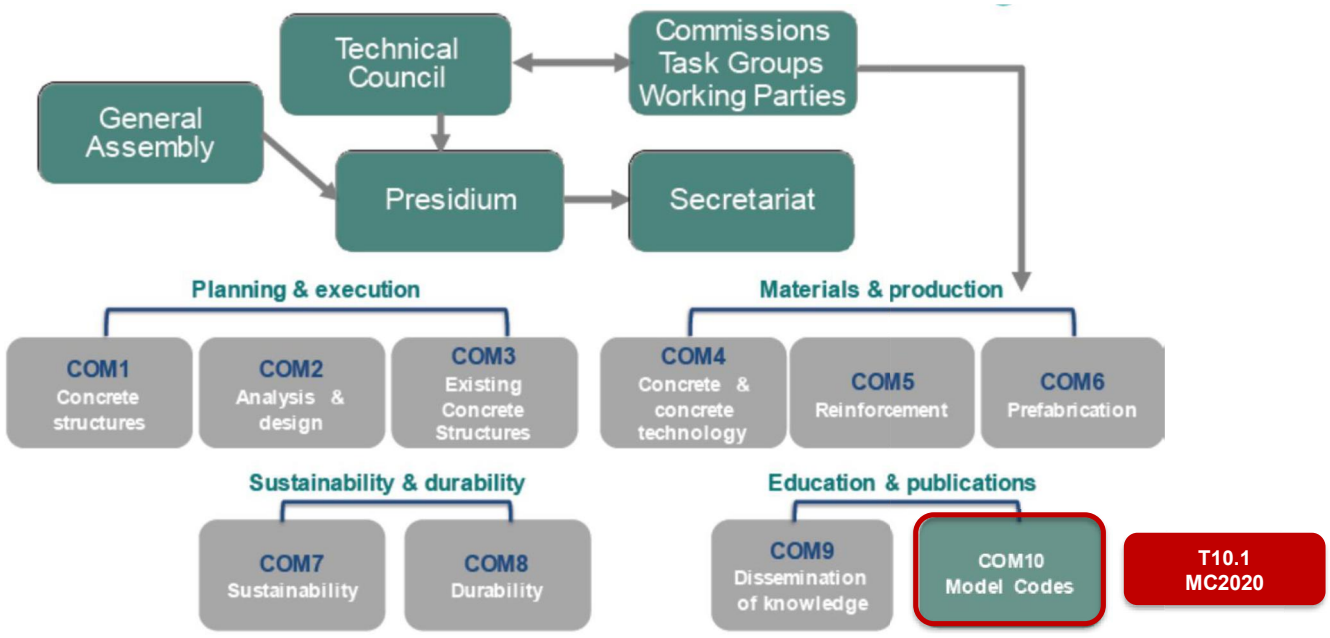
7. Design procedure
• **Conceptual design**
• **Structural analysis and dimensioning**
• **Design verification**
• **Detailing incl. fastenings**
	7. Design and assessment procedures
	• **Conceptual approach to design and assessment**
	• **Structural analysis and dimensioning**
	• **Design, assessment & re-design verification incl.**
	  • verification assisted by models
	  • verifications assisted by numerical simulations
	  • verification assisted by monitoring and testing
	• **Detailing incl. fastenings**
	• **Verification of effectiveness of measures and interventions**

MC2020 CONTENTS PROPOSAL

MC2010 Part IV: Construction	MC2020 Part IV: Construction

8. Construction
• **New works**
  • Execution management
  • Reinforcing steel works
  • Prestressing works
  • Non-metallic reinforcement
  • Falsework and formwork
	8. Construction
	• **New works**
	  • Execution management of new works
	  • Reinforcing steel works
	  • Prestressing works
	  • Non-metallic reinforcement
	• **Works on existing structures**
	  • Execution management of works on existing structures
	  • Execution of interventions

MC2010 Part V: Conservation	**MC2020 Part V: Conservation**
9. Conservation • **Provisions for condition assessment , evaluation, decision-making & interventions**	**9. Through-life management, conservation & care** • **Use and conservation by through-life management** • **Conservation by interventions (physical works)**
MC2010 Part VI: Dismantlement	**MC2020 Part VI: Dismantlement**
10. Dismantlement	**10. Dismantlement** **11. Recycle and reuse**



ORGANIZATION FRAMEWORK FOR MC2020

T10.1 : co-ordinating & drafting body for MC2020 (COM10: T10.1)		
	Chair:	**Stuart Matthews (BRE, UK)**
	Co-Chair:	**Giuseppe Mancini (Uni.Torino, Italy), Joost Walraven (TUDelft, NL)**
	Deputy-Chair:	**Agnieszka Bigaj-van Vliet (TNO, NL)**
	Technical Secretary:	**Gerrie Dieteren (TNO, NL)**
Representatives of **all fib Commissions**		
Regional contacts : **Africa, Asia, Europe, North America & South America**		
Contacts for international organisations inc. bodies such as **CEN, ISO, JCI, ACI, PCI, JCSS & RILEM**		
Other invited fib members		
Action Groups: Databases, Shear & Punching, Bond, Durability & Service Life Prediction, Detailing, Fire, Seismic Design & Assessment, NL FEM, SHM & Testing, Robustness, Fatigue, Impact & Explosion		

Final decisions regarding membership are taken in conjunction with the Technical Council and the COM10 Chair

TIMELINE FRAMEWORK FOR MC2020

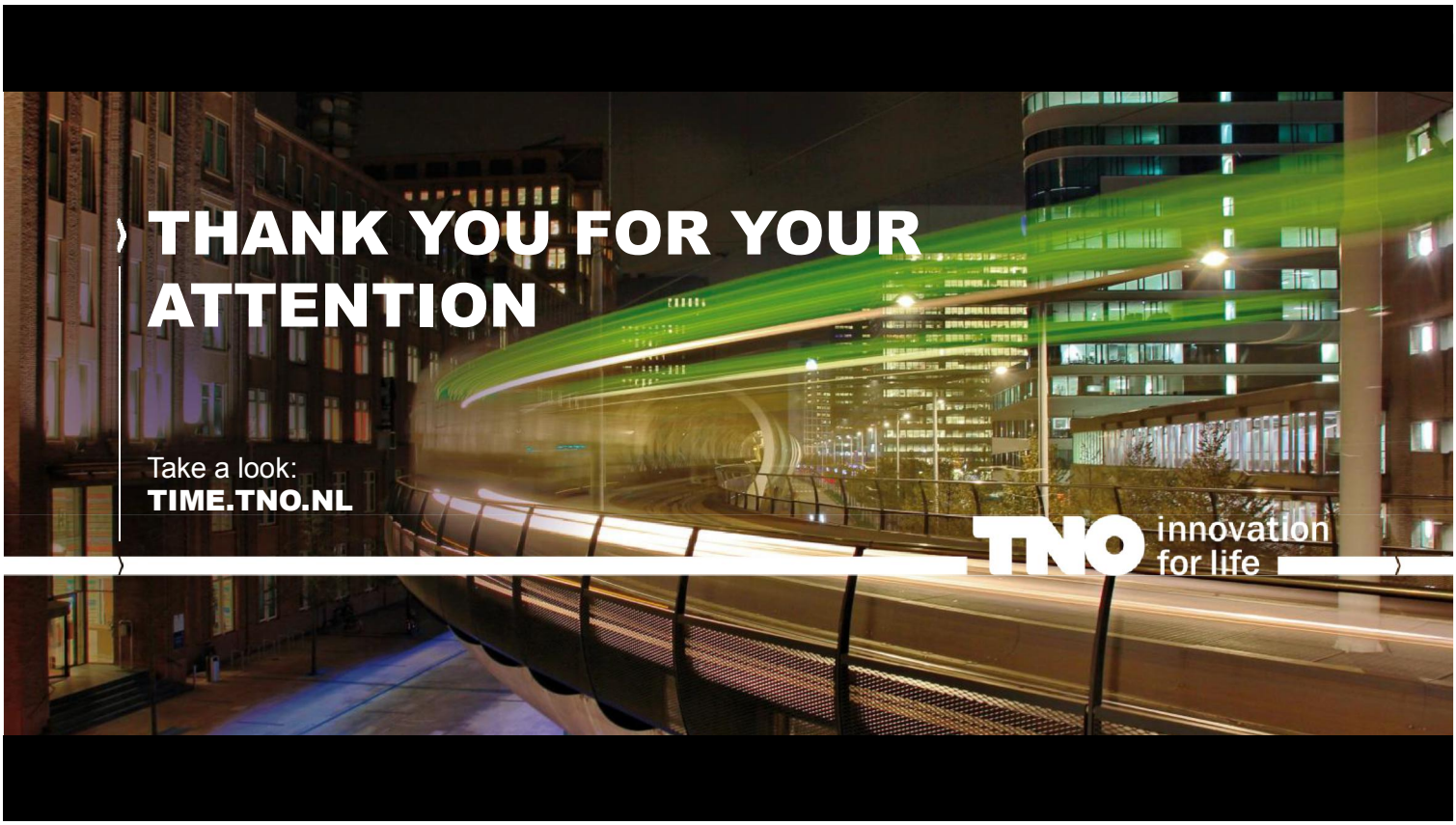
June 2015	*fib* workshop on Advancing the *fib* Model Code for Concrete Structures, The Hague, Netherlands: identifying needs and possibilities for provisions for existing concrete structures
Dec 2015	Core Group meeting to identify topics, the desired contents and roadmap for MC2020
Feb 2016	Submission of the roadmap for M2020 to the *fib* Presidium
Mar 2016	Decisions on the roadmap for M2020 by the *fib* Presidium
June 2016	Decision on establishing COM10 and T10.1 by the *fib* Technical Council
Sept 2016	JCI-*fib* Joint Workshop on Codes for Existing Structures and MC2020, Tokyo, Japan, to stimulate participation of Asia
Okt 2016	T10.1 MC2020 Kick-off meeting, Lausanne, Switzerland: establishing a shared vision on specific tasks, set draft contents for MC2020 & formulate timetable proposal

TIMELINE FRAMEWORK FOR MC2020

Nov 2016	MC2020 regional workshop, to stimulate participation of Africa - link to the *fib* Symposium in Cape Town, Republic of South Africa
2017	Start of delivery of *fib* Bulletins from the supporting work program of commissions
Mar 2017	T10.1 MC2020 meeting, Delft, the Netherlands: finalizing draft contents and timetable for MC2020 & initiating drafting process
June 2017	Special session on Advancing fib Model Code for Concrete Structures on *fib* Symposium in Maastricht
July 2017	Dissemination of the vision on MC2020 in *Structural Concrete*
Sept 2017	MC2020 in ICDC 2017 in Chennai, India, to stimulate link with RILEM
Sept 2017	MC2020 regional workshop in São Paulo, Brazil, to stimulate participation of South America
Oct 2017	MC2020 in ICDC 2017 in Adelaide , Australia, to stimulate participation of Australia

TIMELINE FRAMEWORK FOR MC2020

April 2018	MC2020 regional workshop in Denver, USA, to stimulate participation of North America - link to PCI
Oct 2018	Report of drafting of MC2020 presented at *fib* Congress in Melbourne, Australia
May 2019	MC2020 regional workshop in Shanghai, China, to stimulate participation of Asia
May 2019	Report of drafting of MC2020 presented at *fib* Symposium in Krakow, Poland
2020	First compete draft of *fib* MC2020 for review and comment by *fib* Technical Council, *fib* Commissions, *fib* National Groups, *fib* members, etc.
2021	Final draft of MC2020 presented at *fib* Symposium / Congress & voting by *fib* General Assembly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