Commission 3 Existing concrete structures

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Nakamura	Nagoya University	Japan
Stauder	Bundesanstalt für Wassenbau	Germany

(*fib* members listed in **bold**)

Recent meetings:

Online meeting (February 2015)

Terms of reference

Motivation/background (in brief)

The goal of Commission 3 (COM3) is to define appropriate and reliable procedures to establish the safety of existing structures and any associated requirements for interventions to extend the safe operation or working life of such structures.

It will deliver this through the preparation of comprehensive guidance for the assessment of existing concrete structures, with this providing complementary recommendations to those given in the *fib* Model Code for Concrete Structures 2010 (*fib* MC2010), which was prepared primarily for the design of new concrete structures. To that end, COM3 will produce documents supporting the development of *fib* Model Code 2020 (*fib MC2020*) to be used for the assessment of the present structural performance and the prediction and evaluation of future structural performance of existing concrete structures with or without damage and/or revised operational requirements, together with any associated interventions required to extend their service life. It is envisaged that the documents to be produced could include technical reports, reviews of the state of the art and technical history/evolution, technical guidelines, specifications and recommendations.

The *fib MC2020* will be a future oriented code, intended as a basis for national and international codes concerned with the assessment and management of existing concrete structures. The work of COM3 will employ progressive and targeted structural assessment procedures and utilise reliability-based principles as a guiding philosophy. It is envisaged the document will include the definition of appropriate and reliable procedures / specification of methods for:

- the assessment of the actual structural performance of existing structures
- the prediction of the evolution of actual structural performance with time
- the evaluation of actual performance relative to the specified requirements, with regard to factors such as safety, robustness, vulnerability, serviceability, durability and sustainability during the residual service life
- the selection of appropriate procedures for managing the existing structure and / or for identifying and performing interventions required to preserve or establish the desired safety level or to extend the service life of the structures concerned.

Special attention will be given to:

- structures which have experienced structural deterioration/damage,
- circumstances where the operational requirements have been modified, potentially requiring enhanced structural capacity.

As bases for the *fib* MC2020, various documents (e.g.. *fib* bulletins, technical papers in *Structural Concrete*) will be written by the task groups of COM3, which will serve as bases and background for the *fib* MC2020 and may include reviews of the state of the art and technical history/evolution, technical guidelines, specifications and elaboration of detailed recommendations. COM3 will commence its work by extending the results achieved by the former SAG7. Completion of the work by COM3 in support of the new *fib* MC2020 is currently targeted for 2023.

It is envisaged that the task of preparing *fib* MC2020 will be taken on by a yet to be created COM10.

The planned activity of COM3 will involve five task groups, with these being initiated and terminated as the programme of work progresses through its different phases. The planned task groups are:

T3.0: Liaison with COM10 developing MC2020

T3.1: Reliability and safety evaluation: full-probabilistic and semi-probabilistic methods for existing structures

T3.2: Modelling of structural performance of existing concrete structures

T3.3: Assessment/evaluation and decision-making procedures for the through-life management of existing concrete structures

T3.4: Selection and implementation of interventions / through-life management activities and measures for concrete structures

Expected outcome and delivery dates

Source documents to be developed to support the preparation of the *fib* MC2020

2016: Draft contents of the *fib* MC2020 and identification of author / contributing groups (by COM10)

- *fib* bulletin on “Partial Factor Methods for Existing Concrete Structures” (T3.1)
- technical report on provisions for determination of the actual condition of non-deteriorated components of steel and concrete (T3.2),
- technical report on provisions for determination of the structural safety according to advanced analysis methods (T3.2),
- technical report on provisions for determination of the bearing capacity of structures with sub-optimal detailing (T3.2).
- state of the art report on tools and techniques for surveys and monitoring of the addressed deterioration mechanisms (T3.3).
- state of the art report on available intervention methods and guidelines selection and implementation of interventions (T3.4)

2017: Anticipated delivery of technical guidelines or *fib* Bulletins relating to the work programme of COM3

- technical report incl. provisions on determination of the actual condition of deteriorated components of steel and concrete (T3.2),
- technical guideline on the characterisation of deterioration mechanisms and prognosis methods for practical engineering purposes (T3.3),
- technical guideline on tools and techniques for surveys and monitoring of the addressed deterioration mechanisms (T3.3).

2018: Anticipated delivery of technical guidelines or *fib* bulletins relating to the work programme of COM3

- technical guidelines on risk acceptance and decision making for existing structures (T3.1)
- technical guidelines on determination of the bearing capacity of structures with damaged components (T3.2),
- technical guidelines on determination of the remaining service life of the structure (T3.2),
- technical (background) report to the assessment provisions for existing concrete structures (T3.2),
- technical guidelines on serial conservation and repair measures and the associated degradation processes (T3.3),
- technical (background) report on the technical provisions on assessment, evaluation and decision-making procedures for the through-life management of existing concrete structures (T3.3),
- technical guideline on the selection and implementation of interventions (T3.4).
- technical (background) report on through-life management activities and measures for concrete structures (T3.4).

2019: Anticipated delivery of technical guidelines or *fib* bulletins relating to the work programme of COM3

- technical guidelines on probabilistic models and Bayesian updating framework for the assessment of existing structures (T3.1)
- technical guidelines on full-probabilistic analysis of existing structures (T3.1),

2020-2021: Anticipated delivery of technical guidelines or *fib* bulletins relating to the work programme of COM3

2022: First draft of the *fib* MC2020 presented at the *fib* symposium for review and comment by the *fib* Technical Council, *fib* Commissions, *fib* National Groups, *fib* members, etc., (by COM10)

2023 Draft of final version of the *fib* MC2020 available for presentation at the *fib* congress and for voting by the *fib* General Assembly (by COM10)

NB: The actual nature and number of publications are still to be finalised by the COM3 task groups.

Task Group 3.0: Liaison with COM10 developing the *fib* Model Code 2020

General

fib Task Group 3.0 will serve as a liaison between COM3 and COM10 developing the draft Model Code for Concrete Structures (*fib* MC2020).

Task Group 3.1: Reliability and safety evaluation: full-probabilistic and semi-probabilistic methods for existing structures

Convener:

Caspeele	Magnel Lab for Concrete Research	Belgium

Co-Convener:

Steenbergen	TNO Structures and Safety	Netherlands

Secretary:

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Prieto	Instituto Eduardo Torroja	Spain
Tanner	Instituto Eduardo Torroja	Spain
Thöns	TU Denmark	Denmark
Weber	TU Kaiserslautern	Germany

Corresponding Members:

Linneberg	COWI	Denmark
Schnell	TU Kaiserslautern	Germany

(*fib* members are listed in **bold**)

Terms of reference

Motivation/background (in brief)

fib Task Group 3.1 (T3.1) focuses on the reliability and safety evaluation of existing structures and focuses on the development of risk and reliability target levels for assessment and retrofitting, the full-probabilistic modelling of the structural safety and semi-probabilistic assessment methods for existing structures.

Scope and objective of technical work

The first task of T3.1 will be to finalize a bulletin with respect to "*Partial Factor Methods for Existing Structures*" which is the outcome of the work performed by the previous WGA2 of *fib* Special Activity Group 7. The first draft of the bulletin will be finalized in 2016.

Further, the scope of the previous activities will be broadened in order to (i) resolve pending questions with respect to the full-probabilistic assessment and target safety levels for the assessment and retrofitting of existing structures, and (ii) support the risk and reliability related questions arising due to the developments in T3.0, T3.2, T3.3 and T3.4.

Future working topics are likely to include:

- Risk acceptance and decision making for existing structures
    - Target reliability levels for existing structures, considering human safety criteria and cost optimization for structural elements as well as structural systems
    - Risk differentiation with respect to consequences and structural importance, for individuals and groups as well as for individual structural systems and groups of structures

- Risk acceptance for monumental structures
- Risk acceptance in case of active/passive control and/or monitoring systems and the applicability of "clever" monitoring systems for the through-life management of some existing structures
- Decision making tools (such as pre-posterior analysis tools) with or without Bayesian updating based on inspection and testing

- Probabilistic models and Bayesian updating framework for the assessment of existing structures
  - Prior probabilistic models for actions on existing structures and updating based on in-situ data: imposed loads, climatic actions, seismic actions, traffic actions, accidental actions
  - Prior data to be used in a Bayesian updating framework (material / actions)
  - Prior probabilistic models for deterioration models and updating based on in-situ data (together with T3.2 and T3.3)
  - Investigating quality of inspection/updating information (together with T3.3)
  - Bayesian updating of load models and/or resistance based on proofloading (evidence based updated of model uncertainties) and/or information based on laboratory / in-situ / visual inspection (updating population related properties)
  - Reliability-based evaluation of in-situ strength estimation methods and framework for selection of type and number of tests
- Full-probabilistic and semi-probabilistic analysis of existing structures
  - Model uncertainties related to schematization, conversion, deviation between in-situ properties and laboratory measurements, …
  - Model uncertainties related to design equations and empirical models (together with T3.2)
  - Full-probabilistic analysis based calibration of partial factors for existing structures
  - Framework for the verification of critical assumptions before interventions
  - Global safety format for NLFEM analysis in case of existing concrete structures
  - Methods for the minimization of the number of numerical NLFEM calculations for reliability-based assessment and evaluation of their accuracy
  - Development of model uncertainties to be used in NLFEM-based reliability analyses

Expected outcome and delivery dates

Initially, attention will be given to developing a technical guideline for assigning target reliabilities and making a suitable risk differentiation for existing and monumental structures, considering both individuals and groups.

At the same time a technical guideline will also be developed in order to clarify the way in which appropriate laboratory and in-situ strength estimation methods can be chosen, considering their performance and influence with respect to the use of reliability-based assessment procedures.

Both technical guidelines – as well as further technical guidelines which will be developed in relation to the mentioned working topics – will be passed to TG3.0 so that these topics can be incorporated into the proposed *fib* MC2020.

Task Group 3.2: Modelling of structural performance of existing concrete structures

Convener:

Walraven	Delft University of Technology	The Netherland

Co-Convener:

Coronelli	Politecnico di Milano	Italy

Secretary:

Zandi	Tech Research Institute of Sweden	Sweden

Members:

Andrade	Instituto Eduardo Torroja	Spain
Belletti	University of Parma	Italy
Bertagnoli	Politecnico di Torino	Italy
Bigaj-van Vliet	TNO	The Netherlands
Cervenka	Cervenka Consulting	Czech Republic
Chrysostomou	Cyprus University of Technology	Cyprus
De Boer	Mot Infrastructures	The Netherlands
Dieteren	TNO	The Netherlands
Dunkelberg	TU Munchen	Germany
Hendriks	TU Delft	The Netherlands
Hendy	Atkins	UK
Kuchma	University of Illinois	USA
Leon Gonzales	FHECOR Consultant Engineers	Spain
Matthews	Building Research Establishment Ltd	UK
Meda	University of Rome "Tor Vergata"	Italy
Nuti	University of Rome	Italy
Rinaldi	University of Rome "Tor Vergata"	Italy
Sigrist	Lucerne School of Engineering & Architecture	Switzerland
Strauss	University of Natural Resources and Applied	Austria
Tondolo	Politecnico di Torino	Italy
Ueda	Hokkaido University	Japan
Várdai	ÉMI-TÜV SÜD Ltd	Hungary
Zilch	TU München	Germany
Zwicky	ETH	Switzerland

(*fib* members are listed in **bold**)

Terms of reference

Motivation/background

It is widely understood and accepted that existing concrete structures are different entities to contemporary new concrete structures. There are numerous flexibilities inherent in the process of the design of new concrete structures and in their construction. Correspondingly existing structures are entities that can, in principle, be interrogated and assessed to establish their actual nature and condition. However, such processes have their difficulties and uncertainties and it is, in reality, often very difficult to interrogate an existing structure. These difficulties are compounded when an existing structure has experienced damage or deterioration. Accordingly, substantial and different uncertainties remain with respect to existing structures, which need to be taken into account in the structural assessment process.

Existing structures have typically been designed with reference to a more limited set of principal design criteria than are used now for the design and construction of contemporary concrete structures. Structural safety and serviceability were the principal foci in designs undertaken to the CEB/FIP Model

Code 1990, as well as in many other older structural design standards. Durability was a marginal design aspect, which only gained much greater significance in the last few decades.

This means that the remaining service life of existing structures has to be determined first, in order to place the structure into a suitable maintenance and inspection program. The assessment of the structure with regard to its actual structural capacity and the potential change of this capacity with time is therefore an essential precondition for making appropriate structure management and intervention decisions.

Even with regard to the main design criteria of structural safety and serviceability, as used in the past, there are critical factors to be considered. Also as the state-of-the-art concerning the behaviour of concrete structures was still at a relatively early stage of development in those days, we can now be confronted with inappropriate structural details and sub-optimum behaviour of regions of the structure with regard to the most important failure modes such as shear, punching and torsion.

Existing structures are composed of materials with different properties and characteristics to those now employed in the design and construction of contemporary concrete structures. For example, the concrete strength used in the design of structures decades ago was much lower than that employed today. However, the concrete strength measured in the structure may be actually much higher than reported in old design documents, because of continuing hydration of the coarse cement particles.

The determination of the actual properties of old concrete, possibly influenced by deterioration processes, may also be an important aspect in the evaluation of the actual bearing capacity of an existing concrete structure.

In addition, certain structural components are not used anymore, such as plain reinforcing steel. Most modern codes and recommendations are based on the assumption that ribbed reinforcing steel bars are used as reinforcement and, accordingly, do not include provisions for their use or evaluation. Thus, many modern design rules have limited applicability for use in the assessment of the many somewhat older existing structures.

Scope and objective of technical work

The following aspects related to the modelling of structural performance will be addressed:

- Information on old materials
- Strength, durability etc.
- Strength determination of concrete (by testing)
- Reinforcing & prestressing steels and prestressing systems (Strength determination of reinforcing and prestressing steel by testing)
- Bond of embedded reinforcement / Bond of corroded reinforcing steel, structural steel sections, unbonded steel, bond in frost damaged concrete
- Conceptual design - Minimum information for assessment / robustness evaluation
- Compressive membrane action (Verification of structural safety for static loading)
- Extension of existing strength models (Verification of structural safety for static loading)
- Strength of deteriorated structures in general (corrosion etc.)
- Behaviour of structures with deteriorated components – Fatigue and corrosion (Verification of structural safety for non-static loading)
- Durability – rate of corrosion / ASR etc. (Verifications of limit states associated with durability)
- Nonlinear finite element analysis (Verification assisted by numerical simulations)
- Verification assisted by testing - Proof loading
- Effect of details in old structures (Influence of detailing on ULS performance)

Description of workflow and timeline

Assessing the condition of existing concrete structures

In order to be able to establish the condition of an existing structure with regard to its actual structural safety, serviceability and remaining service life, additional information in a number of areas is required. This will be treated in the following subtasks.

- Determination of the actual condition of the components steel and concrete

The strength of the concrete can be determined using various techniques, both destructive and non-destructive. Cores can be drilled in order to determine the concrete strength, which requires a sound statistical basis to turn the data obtained into strength characteristics with appropriate reliability. Another aspect is the determination of the mechanical properties of the concrete, subject to the deteriorating effect of alkali aggregate reaction, frost thaw cycles, sulphate attack and so on. With regard to the effect of fatigue, the state of damage has to be determined in order to be able to assess the remaining service life. Moreover the physical condition of the concrete should be determined In this respect the chloride profile can give valuable information, as well as the study of carbonation depth and the effects of other chemo-physical phenomena. An inherent aspect to be considered is the probabilistic nature of such phenomena (chloride content at a certain location and spatial spreading in the structure).

Also the assessment of the condition of reinforcing and prestressing steel is necessary for the determination of the residual service life. This means that the degree of corrosion of the steel should be well determined, including the probability that in critical regions the cross section is reduced to such an extent that the structural safety of the structure is endangered.

- Determination of the structural safety of the structure according to advanced methods of analysis

Most actual codes have been written for new structures to be designed. Simplicity and transparency of code rules has been regarded as priorities, based on the consideration that the eventual residual capacity, going along with simplified rules, may be an advantage in future. Nowadays the assessment of structural safety does not take profit of transparent and simple code rules, because those rules may be influenced by inherent conservatism. To cope with this the fib Model Code 2010 gives various levels of approximation for most of the failure modes considered. This means that simple rules can be used for the design of new conventional structures, but that more advanced rules can be used in case it is important to determine the bearing resistance of an existing structure as accurately as possible, in order to avoid unnecessary strengthening and upgrading measures. In this respect it should be clarified how the highest level of approximation should be used for existing structures. In some respects it should be even strived after further refinement of the highest levels of approximation. An example of this is the extension of the punching shear models to cope with the favourable influence of compressive membrane action.

- Determination of the bearing capacity of structures with sub-optimal detailing

Methods should be defined to determine the structural safety of structures with sub-optimal detailing. This can refer to too short anchorage lengths according to superseded design rules from the past, lack of splitting reinforcement, inappropriately reinforced shear and/or punching regions, too large stirrup distances, insufficient reinforcement for crack width control, etc. Moreover, the effect of plain steel, often used in the past, on the bearing resistance of structures should be well determined. With respect to careful determination of the bearing capacity an appropriate analysis of the structure by nonlinear finite element programs is an interesting option to be further explored and developed. Another appropriate method may be proof loading of the structure or a region of it. In this respect appropriate guidance should be given.

- Determination of the bearing capacity of structures with damaged components

Damage can be caused by deterioration of concrete or steel. Alkali aggregate reaction may influence the mechanical characteristics of the concrete, including the effects of heterogeneity, which may reduce the bearing capacity. In this respect the effect of restrained deformation on the spatial variability on the concrete properties (like pre-cracking in unfavourable directions) can be mentioned. The effects of corrosion in RC and PSC structures are cross section losses of concrete and steel and deterioration of concrete strength, steel ductility and bond strength. These items

should be considered modelling a deteriorating corroding RC or PSC structure. To this aim nonlinear models, including NLFE analysis should be considered

- Determination of the remaining service life of the structure

The service life of a structure is defined as the period during which the structural safety satisfies the demands. This can be extended to include the level of serviceability. It should be noted that deterioration mostly does not develop homogeneously along the structure. The degree of deterioration may vary from region to region and it may therefore not be expected that there is a simply defined instant in time that the structural safety is insufficient. It may rather be expected that there is considerable variation of the degree of deterioration in different areas of the structure. Spatial variability is therefore an essential element to be regarded when determining the residual service life of the structure. Prediction of the behaviour (further deterioration of the structure in time) is necessary. On the basis of the behaviour expected, it should be possible to make justified decisions for interference.

Expected outcome and delivery dates

The initial priorities for T3.2 will be:

- Formulation of provisions for the *fib* MC2020
- First draft:
  - Methods for determining of the actual condition of non-deteriorated components of steel and concrete
  - Determination of the structural safety of the structure according to advanced methods of analysis
  - Determination of the bearing capacity of structures with sub-optimal detailing
- Further drafts in 2016-2017 for:
  - Determination of the actual condition of deteriorated components of steel and concrete
  - Determination of the bearing capacity of structures with damaged components
  - Determination of the remaining service life of the structure
- Background report for assessment provisions.
- Evaluation of comments from TG3.0 and other relevant *fib* Commissions and Task Groups on the proposed technical provisions

Collaboration with other groups

Good interaction with T3.1 “Reliability and safety” is required. This applies to the determination of the structural reliability for which no strengthening of the structure is required, and to the structural failure probability which is not acceptable anymore. It should be noted that for structures which are in function already for decades a reduced structural safety may be acceptable. The direct link with TG 3.1 is also necessary, because all deterioration processes involved are of probabilistic nature.

The results of the Task Groups 3.1 and 3.2 should serve as a basis for decision making by T3.3 “Assessments and evaluation procedures” and T3.4 “Interventions”.

Task Group 3.3: Assessment/evaluation and decision-making procedures for the through-life management of existing concrete structures

Convener:

Strauss	Universität für Bodenkultur	Austria

Co-Convener:

Caspeele	Magnel Lab for Concrete Research	Belgium

Secretary:

Campos e Matos	Minho University	Portugal

Members:

Andrade	CSIC	Spain
Bertagnoli	Politecnico di Torino	Italy
Casas	UPC – Barcelona Tech	Spain
Dieteren	TNO	Netherlands
Gulikers	Dutch Ministry of Transport, Public Works and Water Management	Netherlands
Hansen	Leibniz Universität Hannover	Germany
Holicky	Klokner Institute	Czech Republic
Kessler	TU Munich	Germany
Lavorato	University of Rome	Italy
Leon	Politecnica de Madrid	Spain
Mancini	Politecnico di Torino	Italy
Meda	University of Rome	Italy
Middleton	University of Cambridge	U.K.
Monti	University of Rome	Italy
Novak	Brno University	Czech Republic
Nuti	Università degli Studi Roma Tre	Italy
Orlowsky	Dortmund Technical University	Germany
Petraschek	Austrian Railway Agency	Austria
Pielstick	Eisman & Russo	U.S.
Prieto	Torroja Inst. of Construction Sciences	Spain
Ralbosky	Austrian Research Institute	Austria
Sykora	Czech Technical University in Prague	Czech Republic
Tanner	Torroja Inst. of Construction Sciences	Spain
Tondolo	Politecnico di Torino	Italy

(*fib* members are listed in **bold**)

Terms of reference

Scope and objective of technical work

Task Group 3.3 focuses on the development of a set of practical state-of-the-art guidelines for the assessment and decision-making procedures required for the through-life management of existing concrete structures, focusing on:

- advanced assessment techniques for the evaluation of existing structures, both in their current condition and taking account of time-dependent changes which may occur to them;
- simplified assessment approaches for such kind of evaluations; and
- the development of a practical decision-making procedures to perform a complete and coherent assessment of an existing structure.

More specifically the topics to be treated in this task group include:

- Survey and critical analysis of available evaluation / decision-making procedures for the assessment and through-life management of existing concrete structures.
- Development of practical decision making procedures to perform a complete and coherent assessment of existing structures, focusing among others on the development of flow-charts to perform the assessment and the detection of the different considerations that should be made in the assessment process.
- Description of survey processes involving visual examination and utilising various forms of sampling and localised condition testing for a meaningful assessment statement, focusing on the current and future condition of a structure or its components. Survey processes will be classified on the basis of their nature and the methods to be used, their frequency, the planning and timing of surveys.
- Tools and techniques for surveys and monitoring: Description and performance evaluation of available inspection and monitoring tools and techniques to reduce uncertainties associated with input assessment variables of concrete structures.
- Optimizing surveys and monitoring: Proposing and optimizing inspection, testing and monitoring activities for the definition and assessment of criteria associated with the intended service life. The definition of the desired information about the deterioration of materials and / or structural performance will keep in mind likely mechanism(s) and rate of deterioration, environmental conditions, conservation strategies and tactics. The objective is to improve the accuracy of performance prediction of existing structures by well-considered concrete testing.
- Physically-based degradation functions can be controlled using serial conservation and repair measures. A primary objective will be consideration of methods optimizing the use of serial conservation and repair measures, taking account of their respective properties and the influence of time effects, leading towards the definition of decision corridors as a primary output.
- Value of gathered information: Development of procedures for the consideration of the reliability of data gathered with tools and techniques for inspection, testing and monitoring (e.g. combination of visual observations, material sampling and possibly selected non-destructive and non-invasive testing methods).
- Characterization of deterioration mechanisms – benchmarks/synopsis: Definition of deterioration mechanisms and the prediction of damage / deterioration levels to be considered in the assessment approach. This will consider both benchmarks and approaches based on structural performance observed from inspection, testing and monitoring activities, design and construction records, information upon previous interventions and the environmental conditions.
- Prognosis methods for the behaviour of the structure under the envisaged environmental and loading conditions over the remainder of the intended or extended service life, considering the performance requirements that need to be met. Definition of robust models and methods for the characterization of the deterioration level and the rate of change of material properties and / or structural performance based on the results of the inspections/ surveys and / or monitoring carried out and by using appropriate models for the mechanism(s) of deterioration.
- Decision making: Definition and characterisations for robust proactive (i.e. preventative intervention) or reactive (i.e., remedial intervention) intervention planning, depending on the underlying philosophy for the management of the structure. Consideration may also need to be given to changed performance requirements. Further, if inspections undertaken (initial inspections, planned periodic inspections etc) show defects / damage / changes in condition (expected or otherwise) detailed investigation will be specified to evaluate the effects of those defects / damage / changes in relation to the structural performance and emergency measures and performance requirement for the future time will be specified.
- Threshold levels for structural performance – structural decision: The minimum level of performance for the (deteriorated) structure should be determined at the time of design and / or re-design. Accordingly account will need to be taken of the requirements for condition control and the conservation strategy and tactics defined at the time of design and re-design. The level set will take account of the required performance, such as the load carrying capacity

to achieve the required functional performance, as well as issues such as serviceability, and possibly other factors

- General guidance to practitioners undertaking assessments/evaluations of existing concrete structures

Description of workflow and timeline

The initial focus will be on the preparation of a technical guideline for the characterisation of deterioration mechanisms and of suitable prognosis methods that are feasible for practical engineering purposes. At the same time a technical guideline will also be developed in order to clarify tools and techniques for surveys and monitoring of the addressed deterioration mechanisms.

With respect to reliability-based assessment, a primary objective will be the consideration of methods optimising the use of serial conservation and repair measures, taking into account their respective properties and the influence of time effects, leading towards the definition of decision corridors as a primary output.

Other technical guidelines with respect to these serial conservation and repair measures and the associated degradation processes will also be developed.

These technical guidelines will be passed to T3.0 so that these topics can be incorporated into the proposed *fib* MC2020.

Expected outcome and delivery dates

The outcomes of this task group will result in the development of a series of state-of-the-art reports as well as practical guidelines to support the development of an *fib* MC2020.

Task Group 3.4: Selection and implementation of interventions/through-life management activities and measures for concrete structures

Convener:		
Ueda	Hokkaido University	Japan
Co-Convener:		
Mancini	Politecnico di Torino	Italy
Secretary:		
Shimomura	Nagaoka University of Technology	Japan
Members:		
Andrade	CSIC	Spain
Bevc	ZAG Slovenije	Slovenia
Campos e Matos	University of Minho	Portugal
Gehlen	TU München	Germany
Kessler	TU München	Germany
Kobayashi	Gifu University	Japan
Nakamura	Nagoya University	Japan
Papworth	BCRC	Australia
Rahimi	Federal Waterways Engineering and Institute	Germany
Shimata	Civil Engineering Research Institute for Cold Region	Japan
Vitek	Metrostav a.s.	Czech Republic

(*fib* members are listed in **bold**)

Terms of reference

Scope and objective of technical work

The focus will be on the selection and implementation of interventions and through-life management activities and measures for concrete structures. Its final goal is to provide the draft on intervention for the new *fib MC*2020. The basic procedure is updating "Chapter 9 Conservation" of the *fib MC2010*, considering recent progress in this field.

The following aspects related to the intervention are addressed:

- Definition of intervention: Intervention includes measures for prevention, remediation, repair and strengthening. The target improved performance after intervention can be higher than, equal to, or lower than the original design performance level.
- Types of intervention methods: Major types of intervention currently available will be described. The types will be classified according to the objectives, such as mechanical property improvement and durability-related property improvement. The types of intervention will also include activities such as the imposition of load and usage restriction and enhanced maintenance.
- Selection method for intervention: The issues to be considered in the process of selecting an intervention and the steps in the selection process will be addressed. Clause 9.6.4 of MC2010 will be the basis of this activity. There are some missing issues, such as constraints for execution of an intervention (working time and space constraints) and the ease of maintenance and re-intervention after intervention.
- Information needed for design/execution of intervention and method for collecting information (damage existing in structure to be intervened is one of information): For each intervention, there are necessary information on conditions of existing structure before intervention for proper design and execution of the intervention. The information required for each intervention method will be described. For example, cover concrete strength and crack spacing are the necessary information for external bonding, which is a major intervention method for the improvement of mechanical strength of a concrete member.
- Materials for intervention: Materials for intervention are different to conventional materials used in existing concrete structures. Details will be provided about the information on material properties necessary for major intervention methods, such as FRP, PCM and resins.
- Design method for intervention: Design method will be in accordance with the design method for new structures provided in MC2010. However, there are various issues which need to be described where a different treatment or method is required to those employed for the design of new structures, such as taking account of the effects of debonding.
- Execution method for intervention: As each intervention method usually requires a specific execution technique, such as the pre-treatment of the substrate concrete surface, these will need to be described.
- Assessment of performance after intervention: Since continued deterioration after intervention has been observed in many cases in the past, assessment of structural performance after intervention is important. Appropriate methods for the assessment, including monitoring, and of feedback based on the assessment results will be addressed.
- Maintenance and re-intervention of structures after intervention (including assessment of performance of structures after intervention): Proper maintenance after the intervention is made, including monitoring, is important. Re-intervention may be necessary as a planned or as unplanned activity. Necessary information on maintenance and re-intervention can be obtained from the post-intervention assessment. Appropriate methods for maintenance and re-intervention are to be presented.
- Sustainability aspects of interventions (eco-friendly materials, execution method and structural types of intervention): General information on how to make intervention more sustainable (less resource / energy consumption and less carbon burden through life) in terms of materials, execution and maintenance works will be provided.

Description of workflow and timeline

The initial focus will be on the preparation of a technical guideline for the selection and implementation of interventions dealing with current major intervention methods.

With respect to through-life management activities and measures for concrete structures, a primary objective will be updating “Chapter 9 Conservation” of the *fib* MC2010, considering recent technical progress and new ideas.

The work plan will be as follows:

2016-2017: Collection of information on available intervention methods and guidelines in the world

2017-2019: First draft

2020: Further revision of the draft