Material passports: an enabling solution for material use?

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Appendices

Appendix A: In-scope element categories for structural elements

Buildings

RICS *New rules of measurement* (NRM) provides the classification system of buildings' elements. Based on the RICS *Whole life carbon assessment for the built environment*, global, 2nd edn, the in-scope building element categories for structural elements include:

A. 1 Substructure
- 1.1 Foundation and piling
- 1.2 Basement retaining walls and lowest slab (1.2.1 Lowest slab, 1.2.2 Suspended slabs, 1.2.3 Basement retaining walls)

B. 2 Superstructure:
- 2.1 Frame (2.1.1 Frame (vertical) – columns/structural walls and braces, 2.1.2 Frame (horizontal) – beams, joists and braces)
- 2.2. Upper floors, 2.3 Roof (2.2.1 Upper floor and roof – structural slabs, 2.2.2 Upper floor and roof – non-structural slabs)
- 2.4 Stairs, ramps and safety guarding (2.4.1 Stairs)

Refer to Figure E1 (Typical multistorey structural strategy) of the RICS *Whole life carbon assessment for the built environment*, global, 2nd edn.

Infrastructure assets and civil engineering works

The RICS *Whole life carbon assessment for the built environment*, global, 2nd edn, provides a detailed elemental breakdown structure for infrastructure assets/civil engineering works, which is based on the *International Cost Management Standard* (ICMS 3). The in-scope element categories for structural elements include:

A. 02 Substructure: e.g. 02.050 Piling/anchoring, 02.060 Structural backfill/ground remediation, 02.070 Earth-retaining structures, 02.080 Abutments/wing walls

B. 03 Structure: e.g. 03.010 Piers and towers, 03.030 Decks, 03.040 Bearings, 03.050 Tunnel lining, 03.100 Main structures (blindings, slabs, beams, columns and walls)

Appendix B: Concrete – technical properties explanation

The table below specifies the 'required' and 'suggested' properties for concrete that should be documented within MPs:

Concrete		
Required	Composition	Types and proportions of cement, aggregates, additives and admixtures. This information can be documented through the Concrete Mix Certificate
	Compressive strength	The measure of a concrete sample's ability to resist failure under compressive load, expressed in megapascals (MPa) or pounds per square inch (psi)
	Cement replacement type	The use of alternative (supplementary) materials in place of a portion of the cement in a concrete mix, such as fly ash, slag cement, and silica fume
	% cement replacement	The percentage of cement mass in a concrete mix that is replaced by supplementary cementitious materials
	Density	The mass per unit volume, typically measured in kilograms per cubic meter (kg/m^3)
Suggested	Flexural strength	The ability of a concrete specimen (such as a beam) to resist deformation under load, expressed in megapascals (MPa) or pounds per square inch (psi)
	Tensile strength	The maximum stress that the material can withstand while being stretched or pulled before failing or breaking, expressed in megapascals (MPa) or pounds per square inch (psi)
	Modulus of elasticity	A measure of a material's ability to deform elastically (i.e. non-permanently) when a force is applied
	Permeability	The ability of a material to allow liquids or gases to pass through it
	Drying shrinkage	The reduction in volume caused by the loss of moisture from concrete after it has set
	Thermal properties	Properties that describe how the material reacts to changes in temperature. Key thermal properties include thermal conductivity, specific heat, coefficient of thermal expansion

The table below specifies the 'required' and 'suggested' properties for reinforcement that should be documented within MPs:

Reinforcement		
Required	Material type (grade, composition)	Specification of the grade and composition of steel rebar
	Diameter	Refers to the thickness of the reinforcement bars used in construction (1 diameter or range)
	Amount (kg/m^3 concrete)	Indicates the amount of reinforcement steel used per cubic meter of concrete, typically measured in kilograms (kg/m^3). If there is variety on the amount it is suggested that an average value of the amount is used
	Bending schedule and drawings	Detailed documents showing the layout, form, dimensions, and placement of reinforcement bars
Suggested	Yield strength	The point beyond which the steel will stretch without returning to its original shape, directly influencing the safety and stability of structures
	Tensile strength	The maximum stress that the material can withstand while being stretched or pulled before failing
	Bond strength	A measure of the force needed to slide the steel reinforcement relative to the concrete surrounding it, reflecting the effectiveness of the adhesive bond between concrete and steel
	Elongation	A measure of how much the steel can stretch under tensile load before it fails, expressed as a percentage of the original length
	Corrosion resistance	The ability of steel to withstand damage caused by oxidising environments, such as those containing chlorides and carbonates

Appendix C: Structural steel – technical properties explanation

The table below specifies the 'required' and 'suggested' properties for structural steel that should be documented within MPs:

Structural steel		
Required	Material grade	Classification of steel based on its mechanical properties and chemical composition that defines a standard of strength, ductility, etc.
	Material sub-grade	A further categorisation within steel grade that specifies additional conditions of the steel, such as toughness or weldability
	Mill certificates	Official documents provided by steel manufacturers that certify a batch of steel's compliance with the specified standards and grades
Suggested	Yield strength	The point beyond which the steel will stretch without returning to its original shape, directly influencing the safety and stability of structures
	Tensile strength	The maximum stress that the material can withstand while being stretched or pulled before failing
	Elongation	A measure of how much the steel can stretch under tensile load before it fails, expressed as a percentage of the original length
	Modulus of elasticity	A measure of a material's ability to deform elastically (i.e. non-permanently) when a force is applied
	Manufacturing process	Methods used to produce steel, such as hot rolling, cold rolling, or forging
	Chemical composition	The make-up of elements within the steel, including carbon, manganese, etc.

The table below specifies the 'required' and 'suggested' properties for intumescent paint that should be documented within MPs:

Intumescent paint		
Required	Product type	Formulation of the intumescent paint, such as water-based, solvent-based, or epoxy-based
	Fire resistance rating	Measure of the duration, typically expressed in minutes or hours, that the intumescent paint can protect the structural elements from fire
	Certifications and compliance	Certifications to demonstrate that the product has been tested and proven to meet safety, quality, and performance standards
	Manufacturer batch number	The unique identifier for the production lot of the paint
Suggested	Colour and finish	Appearance of the paint once applied and cured
	Application method	Details how the intumescent paint is applied to surfaces, such as brushing or rolling
	Adhesion properties	Describes how well the intumescent paint adheres to the underlying material
	Expansion ratio	Measures how much the intumescent paint expands in volume when exposed to high temperatures