SECTION 01xxxx

LOW CARBON CONCRETE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Design Builder's Responsibilities.
1.1.1.2 Low Carbon Concrete Requirements.
1.1.1.3 Low Carbon Concrete Product Specifications.

1.2 REFERENCES

1.2.1 All web-page references, current as of the release of the Project Manual, are provided as a courtesy.

1.2.2 Bay Area Low Carbon Concrete Codes project, for research and resources related to the standards for low carbon concrete required on this project: https://www.stopwaste.org/concrete.

1.2.3 Carbon Leadership Forum, for research, resources, initiatives to bring embodied carbon emissions of buildings down to zero: https://carbonleadershipforum.org/.

1.2.4 National Ready Mix Concrete Association (NRMCA), concrete industry trade group that provides an industry-wide Environmental Product Declaration (EPD) and industry benchmark report from regular survey of concrete mix designs produced by the ready mix concrete plants among its membership: https://www.nrmca.org/association-resources/sustainability/epd-program/.

1.2.5 Comprehensive Procurement Guidelines, for products designated by the U.S. Environmental Protection Agency for purchase with recovered materials: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program.

1.3 DEFINITIONS

1.3.1 Environmental Product Declaration (EPD): Environmental Product Declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

1.3.2 Global warming potential (GWP): A measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. Gases other than carbon dioxide are multiplied by a characterization factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to that of carbon dioxide over a given period of time, for a total mass value typically reported in units of kg-CO2-equivalent.

1.4 DESIGN BUILDER'S RESPONSIBILITIES

1.4.1 Low Carbon Concrete: Comply with low-carbon concrete standards as developed by the Bay Area Low Carbon Concrete Codes project as specified and as directed by the Alameda County General Services Agency, Office of Sustainability.

1.5 LOW CARBON CONCRETE REQUIREMENTS

1.5.1 Low Carbon Concrete Submittal to County: Design Builder shall supply an updated Low Carbon Concrete Compliance Form (see Attachment A) to the County, at the following times during the project:

1.5.1.1 At 100% Construction Document submittal. At this submittal, the Design Builder shall complete the portion designated as "Design Team to Complete," to demonstrate the plan for compliance with Low Carbon Concrete requirements.

1.5.1.2 Within 6 weeks after completion of concrete work on the project, the Design Builder shall supply the final Low Carbon Concrete Compliance Form, with portion designated as "Concrete Contractor to Complete" filled out. Attach all approved concrete mix or concrete product submittals used for the project. Each mix design number listed on the Low Carbon Concrete Compliance Form must match the mix design numbers shown on the approved mix designs used on the project. For precast products including concrete masonry units, the product names listed on the Low Carbon Concrete Compliance Form must match the product data sheets of approved products used on the project.

1.5.1.3 If pursing the Prescriptive Method, each mix design or product data sheet shall show the cement content of the mix or product.

1.5.1.4 If pursing the Performance Method, each mix design or product data sheet shall supply a Type III Environmental Product Declaration specific to the product.

1.5.1.5 If Contractor chooses to use concrete mixes that exceed cement or GWP limits specified herein, the Contractor must include volumes for each concrete mix or product to show on the completed Low Carbon Concrete Compliance Form that the total concrete cement or GWP remains below the total cement or GWP allowance for the project. Total project cement or GWP allowance is calculated by multiplying the volume of each concrete mix type with the specified GWP limit for the mix.

1.5.1.6 If project uses concrete masonry units (CMU), the Contractor shall follow the CMU guidance notes below the Low Carbon Concrete Compliance Form. Each CMU assembly shall have its own line item and shall be listed with any other concrete used on the project.

1.7.2 Calculation of Estimated Carbon Reduction: Design builder shall provide a calculation of the estimated carbon reduction, as measured from a baseline using the Bay Area Low Carbon Concrete Codes (BALCC) thresholds as shown in Part 2 below. BALCC thresholds are generally

10-30% below the National Ready Mix Concrete Association (NRMCA) Benchmark (Industry Average) Report and provides for certain allowances for special conditions. Calculation methodology and sources shall be documented and transparent, and shall include, at minimum, all concrete types used on the project that are documented in the Low Carbon Concrete Compliance Form.

PART 2 - PRODUCTS

2.1 Low Carbon Concrete

2.1.1 Prescriptive Method - Maximum cement content of a concrete mix using this option for compliance shall not exceed the values shown in the table below:

Minimum specified compressive strength f'_c (psi) at 28 days	Up to 2500	3000	4000	5000	6000	7000 and above
Maximum ordinary Portland cement content (lbs/yd^3)	362	410	456	503	531	594

2.1.1.1 The maximum cement content given in this table can be increased proportionately over the industry average of 1040 kg CO2e/metric ton published by the Portland Cement Association (PCA), when using an approved cement, or blended cement, demonstrated by approved cement EPD to have a plant-specific global warming potential lower than the industry average.

2.1.2 Performance Method – As an alternative to the prescriptive method, concrete mix designs can be based on an approved environmental product declaration (EPD) to verify compliance of the mix design with the values in the table below:

Minimum specified compressive strength f'_c (psi) at 28 days	Up to 2500	3000	4000	5000	6000	7000 and above
Maximum Global Warming Potential, kg CO2e/m3	260	289	313	338	356	394

2.1.3 The maximum cement and GWP limits in tables above can be increased by 30% for concretes demonstrated to the County Project Manager as requiring high early strength. Such concretes could include:

2.1.3.1 Precast concrete

2.1.3.2 Prestressed concrete

2.1.3.3 Retaining walls requiring immediate backfill

2.1.3.4 Shotcrete

2.1.4 The Design Builder may elect to use a volume-weighted limit wherein the cement or GWP limit of each mix or product is multiplied by the volume used of that mix or product to produce a total project cement or GWP limit. The total project cement or GWP within the entirety of concrete work on the project must remain below the total cement or GWP allowance for the project.

2.1.5 For concrete masonry units, compliance with the Low Carbon Concrete Requirements shall be demonstrated through one of the compliance options in the table below.

Minimum specified compressive strength f'_c (psi) at 28 days	1500	2000	2500	3000
Maximum Cement Content of Assembly, lb per cyd	263	310	353	399
Maximum Global Warming Potential of Assembly, kg CO2e/m3	237	250	254	282

2.1.5.1 Option 1, assembly cement = sum of cement in CMU block, grout and mortar, per cubic yard of installed structural element. If the mortar volume is unknown, it may be assumed to be zero. If the units are fully grouted, the volume of grout may be assumed to be 50% of the total assembly.

2.1.5.2 Option 2, a calculation of the total global warming potential (GWP) of the assembly is required that accounts for both the CMU block and grout. Mortar may be included as well but is not required. The calculation should use the GWP from the CMU block environmental product declaration (EPD) and the GWP of the grout must account for the amount of cement it contains. The industry average EPD for CMU block may be used if there is no product-specific EPD. The GWP of the cement component in the grout must come from the most recent Portland Cement Association EPD for cement. See attached spreadsheet for an example of a compliant calculation.

PART 3 - EXECUTION

Not used.

END OF SECTION

ATTACHMENT A: Low Carbon Concrete Worksheets (on following page)

Low Carbon Concrete Compliance Form (maximum cement pathway, Prescriptive Method)

This form shall be completed by the party indicated under each section for compliance with project Low-Carbon Concrete requirements

Project name _____ Date _____

DESIGN TEAM TO COMPLETE FOR CONFORMANCE WITH DIV 01 XX XX						**CONCRETE SUBCONCTRACTOR TO COMPLETE**				
Structural engineer shall complete and include within concrete specification of the Project Manual submitted to the County Project Manager for conformance review with DIVISION 01 xx xx.						*General Contractor shall complete and submit to the Architect and County Project Manager within 6 weeks of completion of the concrete work.*				
Date:						Date:				
Structural Engineer Company Name:						General Contractor Company Name:				
Signature:						Signature:				
Print Name:						Print Name:				
Concrete mixture name	Design strength, f'c **per spec** (psi)	Used for (indicate if needs early strength)	Volume Estimated (cyd)	Max Cement Content **per spec** (lb/cyd)	Cement Limit (lb/cyd)	Volume Supplied (cyd)	Concrete Supplier Name	Concrete Batch Code	Cement Content (lb/cyd)	Cement Limit (lb/cyd)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
These rows only for use if contractor is pursuing budget method		Total cement of all concrete used on Project (lbs)				Total cement of all concrete used on Project (lbs)				
		Total cement allowed for all concrete on Project (lbs)				Total cement allowed for all concrete on Project (lbs)				
Signature of Approval at Plan Check:						Signature of Approval for TCO Permit:				
Print Name:						Print Name:				
Date:						Date:				

Low Carbon Concrete Compliance Form (maximum GWP pathway, Performance Method)

This form shall be completed by the party indicated under each section for compliance with project Low-Carbon Concrete requirements

Project name _____ Date _____

DESIGN TEAM TO COMPLETE FOR CONFORMANCE WITH DIV 01 81 13						**CONCRETE SUBCONCTRACTOR TO COMPLETE**				
Structural engineer shall complete and include within concrete specification of the Project Manual submitted to the County Project Manager for conformance review with DIVISION 01 xx xx.						*General Contractor shall complete and submit to the Architect and County Project Manager within 6 weeks of completion of the concrete work.*				
Date:						Date:				
Structural Engineer Company Name:						General Contractor Company Name:				
Signature:						Signature:				
Print Name:						Print Name:				
Concrete mixture name	Design strength, f'c **per spec** (psi)	Used for (indicate if needs early strength)	Volume Estimated (cyd)	Max Cement Content **per spec** (lb/cyd)	Cement Limit (lb/cyd)	Volume Supplied (cyd)	Concrete Supplier Name	Concrete Batch Code	Cement Content (lb/cyd)	Cement Limit (lb/cyd)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
These rows only for use if contractor is pursuing budget method		Total cement of all concrete used on Project (lbs)				Total cement of all concrete used on Project (lbs)				
		Total cement allowed for all concrete on Project (lbs)				Total cement allowed for all concrete on Project (lbs)				
Signature of Approval at Plan Check:						Signature of Approval for TCO Permit:				
Print Name:						Print Name:				
Date:						Date:				

Guidance Notes for CMU, in accordance with the numbered columns:

(1) Use a unique name for each assembly, matching the mark used in the drawings or specifications if possible.
(2) Use the net area compressive strength of masonry assemblage (f'm) instead of f'c.
(3) Ensure CMU is noted if not noted under (1)
(4) Volume may use the nominal block thickness, e.g. 8" instead of actual 7-5/8", because the limits were derived using nominal dimensions.
(5) Calculate the amount of cement expected in the concrete block and grout specified. Ensure the same maximum cement is stated in the specifications. See Option 1 example above.
(6) Copy value from Table 1
(7) Use actual volume which will change the total cement allowed for all concrete on the project if different from (4)
(8) List CMU supplier
(9) List block and grout used for the assembly. Note percentage of supplementary cementitious materials used in the grout.
(10) Calculate actual amount of cement based on the assembly used for the project
(11) Copy cement limit from (6). Repeated here to allow for adjustment in total cement on project if any actual volumes are different from estimated volumes.