Technical Specifications in Construction Projects

Colegio de Ingenieros y Agrimensores de Puerto Rico

Expo Cumbre 2017

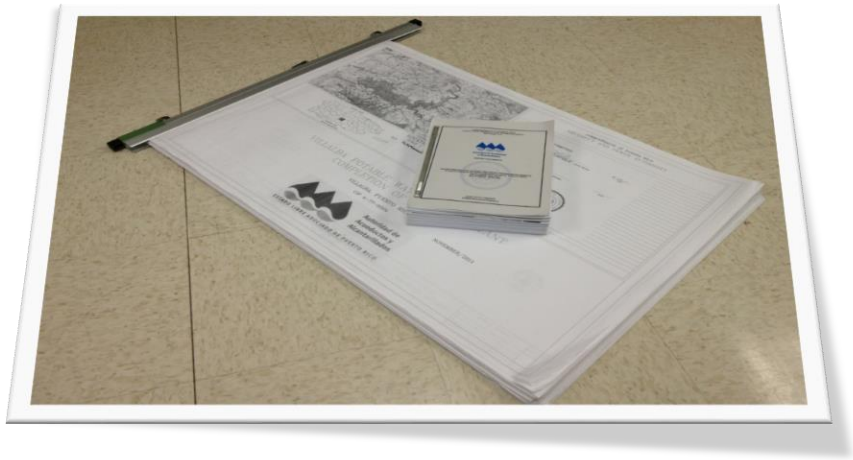
Módulo 1:
INGENIERÍA CIVIL

INSTITUTO INGENIEROS CIVILES CIAPR

CMA ARCHITECTS & ENGINEERS LLC

Agenda

01. ¿Qué es una especificación?
02. Relación entre los planos (dibujos) y el Manual del Proyecto
03. Formatos
04. Métodos
05. Lenguaje
06. Divisiones
07. Certificaciones
08. Referencias
09. Editando Especificaciones



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¿Qué es una especificación?

01

- Latin *specificare*: “mencionar particularmente"
- Descripción detallada del diseño y los materiales necesarios para construir algo.
- Estándar de calidad de mano de obra o materiales requeridos en un trabajo.

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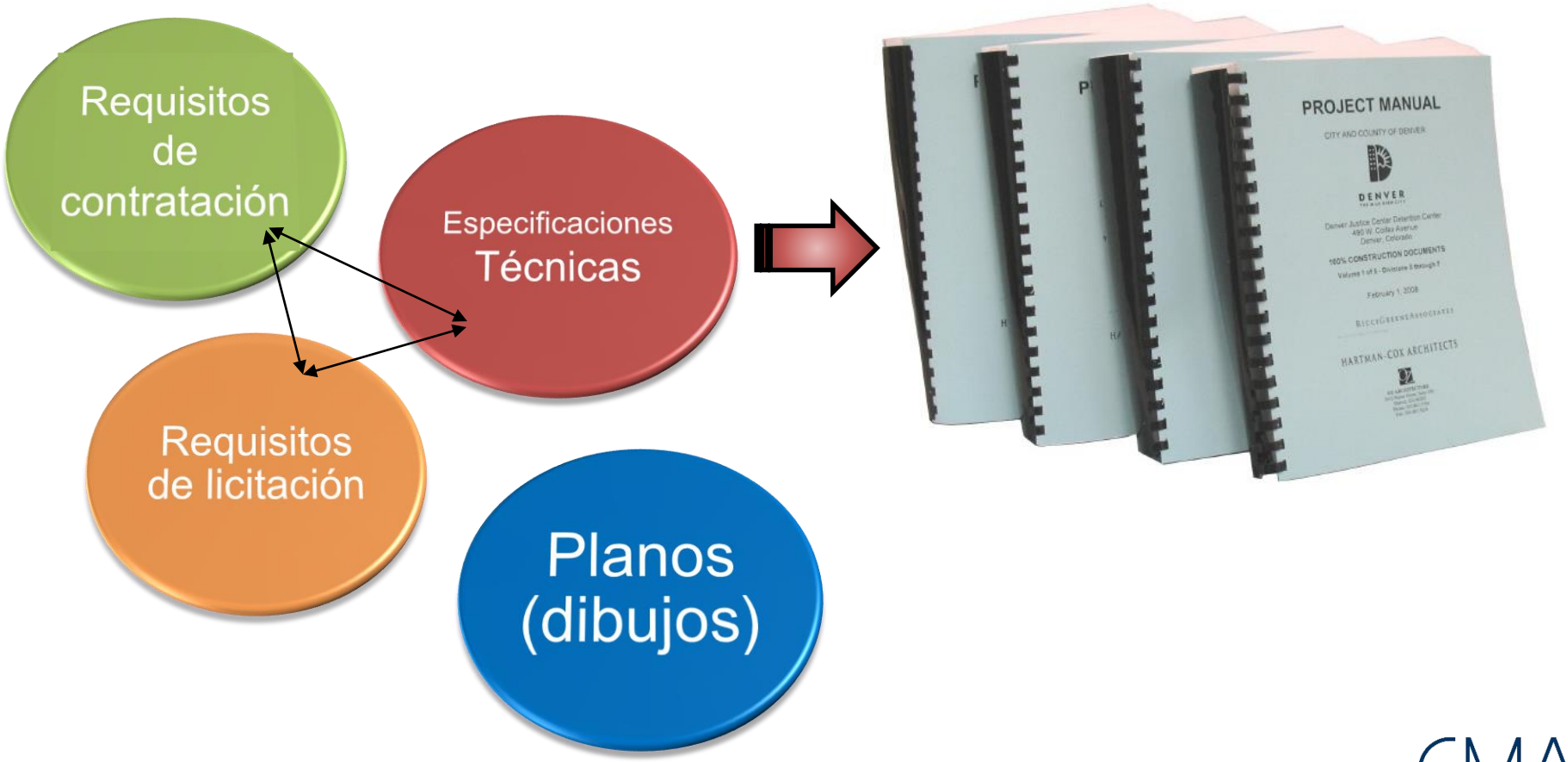
performance
warranties
provisions
contractor
application
perform
specification
complimentary
without
important
properly
notes
proper
produce
aesthetics
inspections
understand
subcontractors
standards
include
sufficient
construct
designers
erected
developers
know
construction
applied
included
building
having
door
owner
owners
Architects
Contractors
words
prepared
believe
work
information
component
required
technical
projects
apply
want
way
come
bids
essential
serve
doing
terms
specifications
select
specific
install
generic
matter
charged
erect
pre
provide
quality
drawings
needed
the
group
role
job
clients
engineers
put
responsibility
product
stops
necessary
project
instruments
testing
control
amounts
constructor
Good
possible
buildings
graphics
service
constructors
success
focus
requirements
submittal
manufacturer
substrate
repository
qualifications
installed
producing

4 documentos en construcción

Todos son documentos legales:



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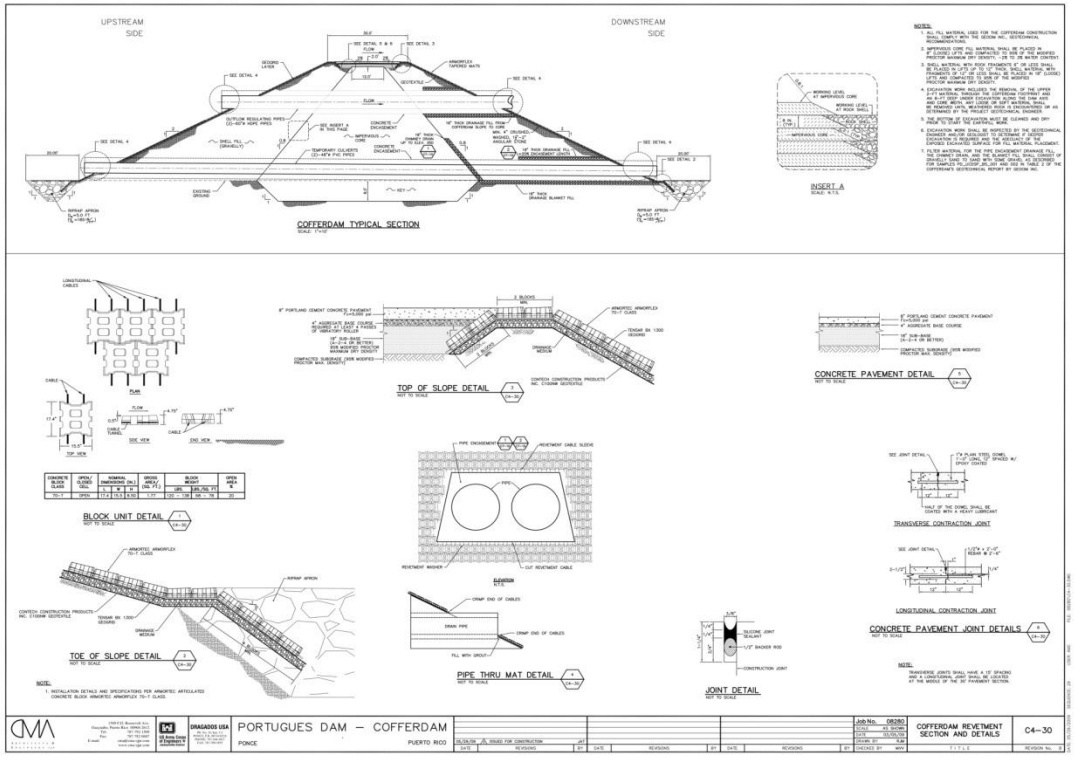
Planos (dibujos)

- Incluyen documentos gráficos y muestran la localización de productos, materiales y equipo.
- Describen los requisitos **cuantitativos** de construcción.



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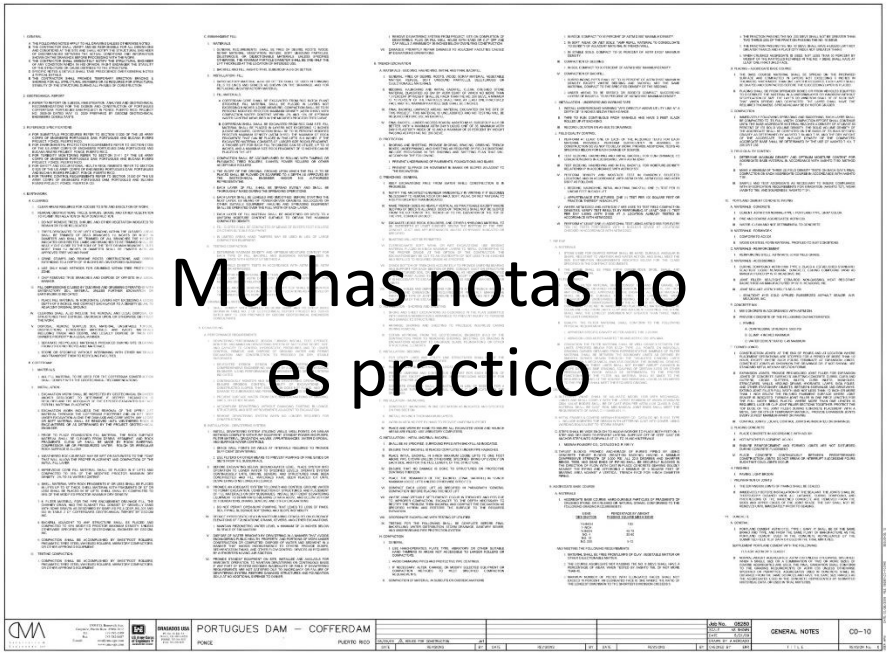
Las especificaciones

- Describen lo que se va a construir, explicando el concepto e idea de una manera directa y fácil de entender.
- Proveen los requisitos **cualitativos** de construcción.



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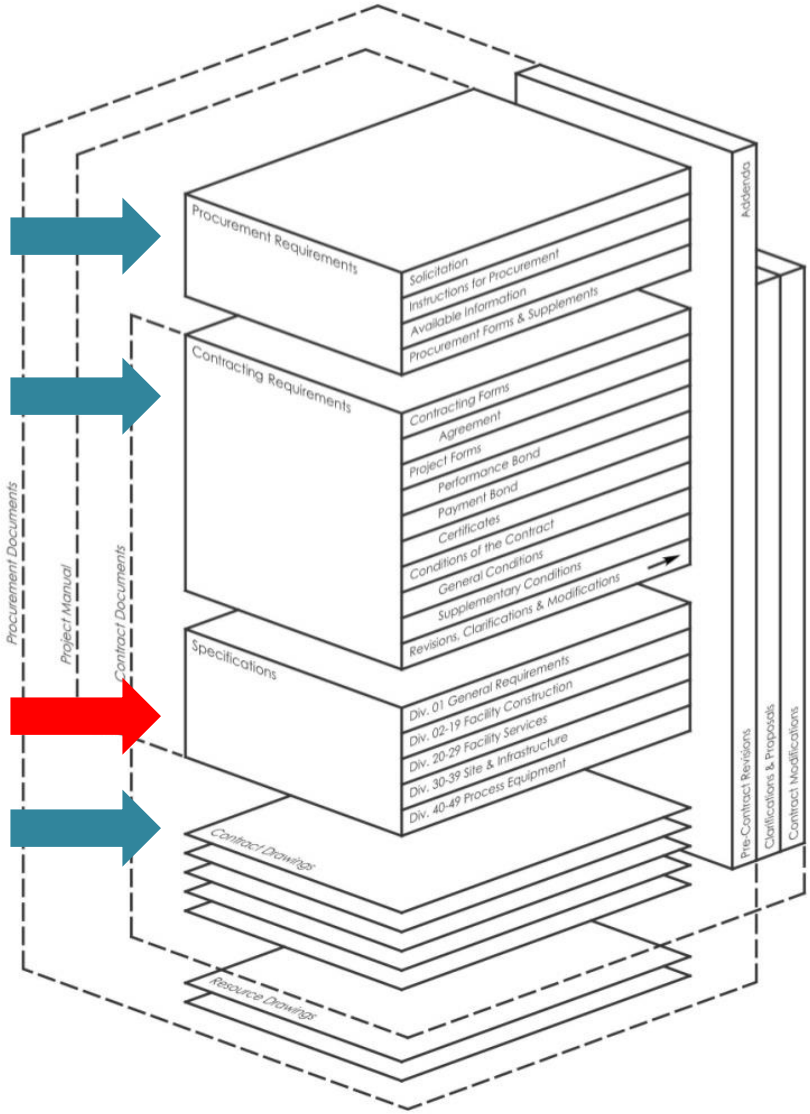
¿Qué es un Manual del Proyecto?



- Las especificaciones están en el **Manual del Proyecto.**
- Documentos de licitación y contrato.
- Especificaciones técnicas
- Documentos organizados sistemática y consistentemente.

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Google Books Ngram Viewer

https://books.google.com/ngrams/

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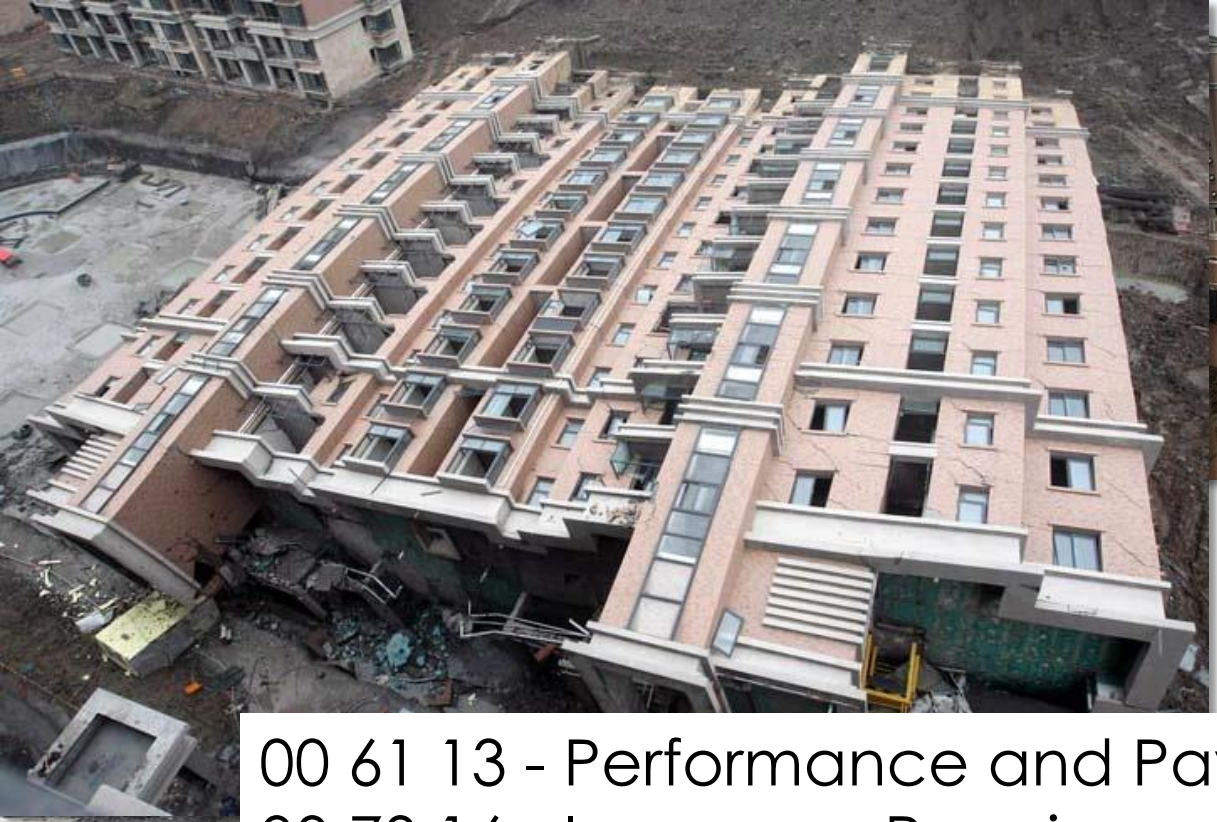

2009

Un edificio de 13 pisos colapsa y mata a una persona en Shangai.

00 61 13 - Performance and Payment Bond Form
00 73 16 - Insurance Requirements

Building collapse kills one worker in Shanghai
By Cao Li (chinadaily.com.cn)
China Daily Information Co (CDIC)

02

Relación entre los planos (dibujos) y el manual del proyecto

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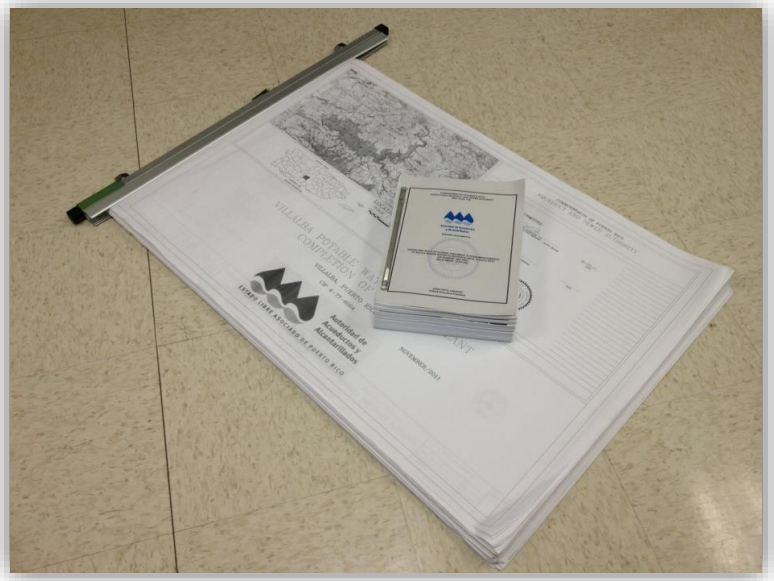
Planos vs. Especificaciones

Comunicación continua y coordinación de la información entre los miembros del Equipo del Proyecto para:



- Reducir errores
- Omisiones
- Duplicaciones
- Inconsistencias entre el Manual del Proyecto y los Planos.

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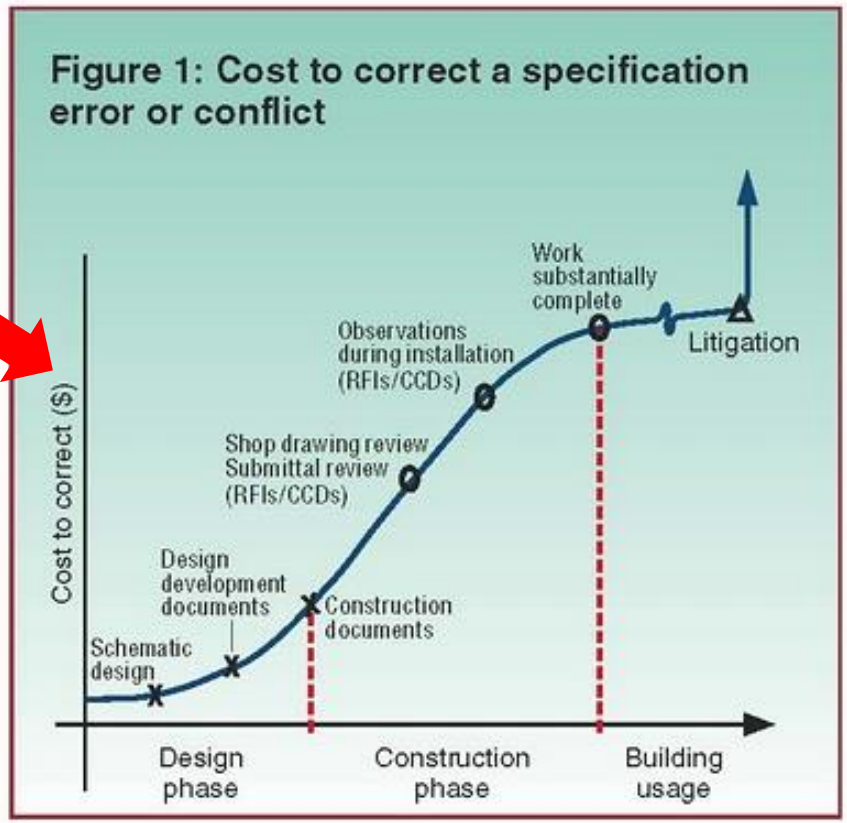
La falta de coordinación es costosa



Graph from "Using Spec Writers Properly"
by Derek B. McCowan, PE
June 2010 issue of *Consulting-Specifying Engineer*

- Los dibujos y especificaciones se complementan.
- "*Say it once and only once.*"

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03

Formatos

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Hay 4 Formatos

New Symphony Hall, Santurce, P.R.

- Organizan de una manera estandarizada toda la información
- Pueden ser usados en diferentes aplicaciones
  - UniFormat™
  - MasterFormat™
  - SectionFormat™
  - PageFormat™

MasterFormat™

- Se basa en las actividades de construcción
- 2 grupos:
  - *"Procurement and Contracting Requirements"*
  - *"Specifications"*
- **48 divisiones**
- *Construction Specifications Institute* (CSI)

Museo de Arte de Ponce Annex Building

MasterFormat™ 2004

Bid & Contract

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

- **Division 00 - Procurement and Contracting Requirements**

General

SPECIFICATIONS GROUP

General Requirements Subgroup

- Division 01 - General Requirements

Facility Construction Subgroup

Arch & Struct

- Division 02 - Existing Conditions
- Division 03 - Concrete
- Division 04 - Masonry
- Division 05 - Metals
- Division 06 - Wood, Plastics, and Composites
- Division 07 - Thermal and Moisture Protection
- Division 08 - Openings
- Division 09 - Finishes
- Division 10 - Specialties
- Division 11 - Equipment
- Division 12 - Furnishings
- Division 13 - Special Construction
- Division 14 - Conveying Equipment
- Divisions 15, 16-20, 24, 29, 30, 36-39, 46, 47 & 49 Reserved for Future Expansion

Facility Services Subgroup

Mech & Elect

- Division 21 - Fire Suppression
- Division 22 - Plumbing
- Division 23 - Heating Ventilating and Air Condition
- Division 25 - Integrated Automation
- Division 26 - Electrical
- Division 27 - Communications
- Division 28 - Electronic Safety and Security

Site and Infrastructure Subgroup

Civil

- Division 31 - Earthwork
- Division 32 - Exterior Improvements
- Division 33 - Utilities
- Division 34 - Transportation
- Division 35 - Waterway and Marine

Process Equipment Subgroup

- Division 40 - Process Integration
- Division 41 - Material Processing and Handling Equipment
- Division 42 - Process Heating, Cooling, and Drying Equipment
- Division 43 - Process Gas and Liquid Handling, Purification and Storage Equipment
- Division 44 - Pollution Control Equipment
- Division 45 - Industry-Specific Manufacturing Equipment
- Division 46 - Water and Wastewater Equipment
- Division 48 - Electrical Power Generation

MasterFormat™

03 00 00 Concrete

03 01 00 Maintenance of Concrete

03 01 10 Maintenance of Concrete Forming and Accessories

03 01 20 Maintenance of Concrete Reinforcing

03 30 00 Cast-in-Place Concrete

03 30 53 Miscellaneous Cast-in-Place Concrete

03 31 00 Structural Concrete

03 31 13 Heavyweight Structural Concrete

03 31 16 Lightweight Structural Concrete

03 31 19 Shrinkage-Compensating Structural Concrete

03 31 23 High-Performance Structural Concrete

03 31 24 Ultra High-Performance Structural Concrete

03 31 26 Self-Compacting Concrete

03 33 00 Architectural Concrete

03 33 13 Heavyweight Architectural Concrete

03 33 16 Lightweight Architectural Concrete

03 34 00 Low Density Concrete

03 35 00 Concrete Finishing

03 35 13 High-Tolerance Concrete Floor Finishing

03 35 16 Heavy-Duty Concrete Floor Finishing

03 35 19 Colored Concrete Finishing

Cada división usa ***SectionFormat***™

PART 1 – GENERAL

1.1 Article
1.1.1 Paragraph
1.1.1.1 Subparagraph

PART 2 – PRODUCTS

2.1 Article
2.1.1 Paragraph
2.1.1.1 Subparagraph

PART 3 – EXECUTION

3.1 Article
3.1.1 Paragrah
3.1.1.1 Subparagraph

WWTP Expansion Guanica

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PageFormat™ *es la presentación*

Top and Bottom margins: ½-inch

Size: 12 cpi

Left and Right Margins: 1-inch

Page No.

Date

PART 2 – PRODUCTS

2.1 ACCEPTANCE MANUFACTURER – HYDRAULIC CEMENT UNDERLAYMENT

A. Ardex Engineered Cements, Inc., Type: Ardex K-15. Self-Leveling Underlayment Concrete.

1. Underlayment: Cementitious based mix.

2. Primer: Ardex P-51 primer.

a. Primer shall have a VOC Content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D.

3.3 PRIMING – CONCRETE SUBSTRATES

A. Primer for standard absorbent concrete subfloors:

1. Mix ARDEX P-51 1:1 with water and apply evenly with a soft pushbroom.

2. Do not leave any bare spots.

3. Remove all puddles and excess primer.

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Otros formatos

Commonwealth of Puerto Rico

DEPARTMENT OF TRANSPORTATION
AND PUBLIC WORKS

PUERTO RICO HIGHWAY AND

TRANSPORTATION AUTHORITY

STANDARD SPECIFICATIONS
FOR
ROAD AND BRIDGE CONSTRUCTION

2005

CONSTRUCTIONS SPECIFICATIONS

150	Survey and Stake-Out	108
151	Mobilization	113

EARTHWORK (SERIES 200)

201	Clearing and Grubbing	116
202	Removal of Structures and Obstructions	125
203	Excavation and Embankment	130
204	Finishing Subgrade	163
205	Trench Excavation	167
206	Excavation for Structures	178
207	Foundation Fill	191
208	Devices for Embankment Construction Control and Ground Water Observations	193
209	Sheathing	203
210	Soil Erosion and Water Pollution Control	207
211	Bridge Approach Embankment	217
212	Reconditioning of Shoulders and Ditches	220

BASE COURSES (SERIES 300)

301	Subbase Course	223
304	Aggregate Base Course	231
305	Lean Concrete Base	238

http://www.dtop.gov.pr/carretera/det_content.asp?cn_id=271

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04

Métodos

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¿Como describo lo que quiero?

Existen 4 métodos:

- **Descriptive**
- **Performance**
- **Reference Standard**
- **Proprietary**

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Ejemplo: un generador eléctrico

Diesel Electrical Generator: 900 kVA, 50 Hz, 720 kW, 400 Volts.

"Descriptive" or "Prescriptive"

- Materiales y métodos
- No incluye manufactureros
- Requiere conocimiento técnico

Electrical Generator Unit: 720 kW, Green Power, Hybrid.

"Performance"

- Criterio de cumplimiento
- El contratista presenta opciones
- Fomenta la innovación

Diesel Electrical Generator: With insulation per ANSI MG 1 - 2011.

"Reference Standard"

- Productos o procesos establecidos por estándares reconocidos
- Edite con cuidado

Diesel Electrical Generator: Caterpillar; model CAT 3412C; 720 kW.

"Proprietary"

- Nombre de marcas y modelos específicos*
- No hay lugar a substituciones

* abiertas o cerradas

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Métodos con el gobierno

- Las agencias de gobierno requieren **especificaciones no propietarias - cerradas**.
- La mayoría prohíbe la inclusión de manufactureros o modelos específicos.

Autoridad de Acueductos y Alcantarillados
ESTADO LIBRE ASOCIADO DE PUERTO RICO

AUTORIDAD DE ENERGÍA ELÉCTRICA DE PUERTO RICO
SELLO OFICIAL

PRIDCO
Puerto Rico Industrial Development Company

AFI
AUTORIDAD PARA EL FINANCIAMIENTO DE LA INFRAESTRUCTURA
Estado Libre Asociado de Puerto Rico

DEPARTAMENTO DE LA VIVIENDA

Manual de Especificaciones Estándares para la Construcción de Carreteras y Puentes
www.dtop.gov.pr/carretera/det_content.asp?cn_id=271

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05

Lenguaje

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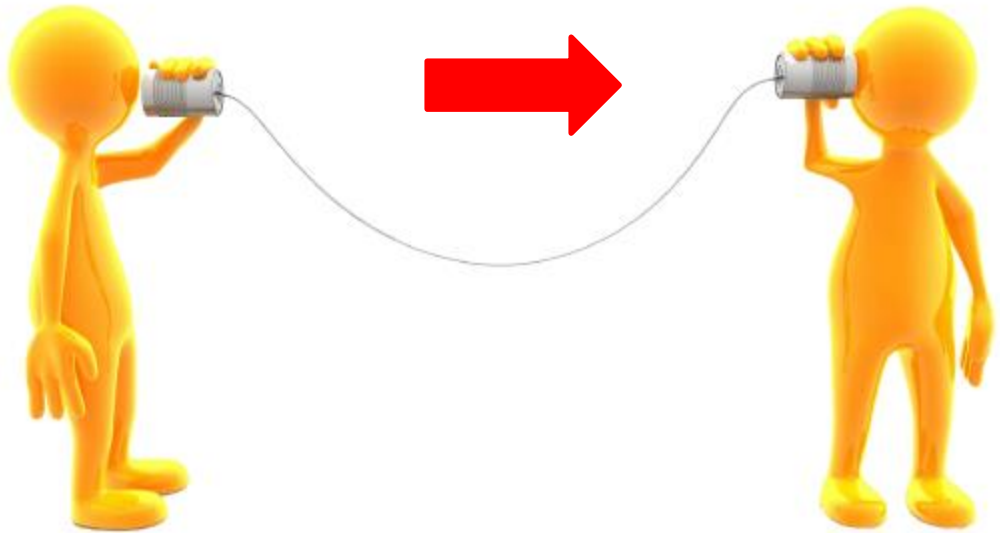
Las 4'Cs para ser efectivo

- **Clear**
- **Concise**
- **Correct**
- **Complete**



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Tramita claramente la directriz

Indicativo

- En voz pasiva, usa el "shall" en casi todas las oraciones.
- Oraciones son largas y monótonas.

✗ "Adhesive shall be spread with notched trowel."

Imperativo

- Empieza con el verbo, que claramente define la acción.
- Es conciso y directo.

✓ "Spread adhesive with notched trowel."

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Vocabulario

Pfizer, Barceloneta

- **Furnish**, **Install**, and **Provide**
- **Replace** and **Provide New**
- **Shall** and **Will**
- No use:
  - "Must"
  - Abreviaciones
  - Negrilla ("bold")

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¿Qué mas no va?

- **No use** "underlines"

- **No use estos símbolos:**
  - % for percent
  - ° for degree
  - + for plus
  - - for minus
  - / for per
  - @ for at
  - “”
  - (…)

- **No use estas frases:**
  - As allowed
  - As appropriate
  - As approved
  - As indicated
  - As required
  - Etc.
  - To the satisfaction of the Architect/Engineer
  - In a workmanlike manner
  - Shall function as intended

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06

Divisiones

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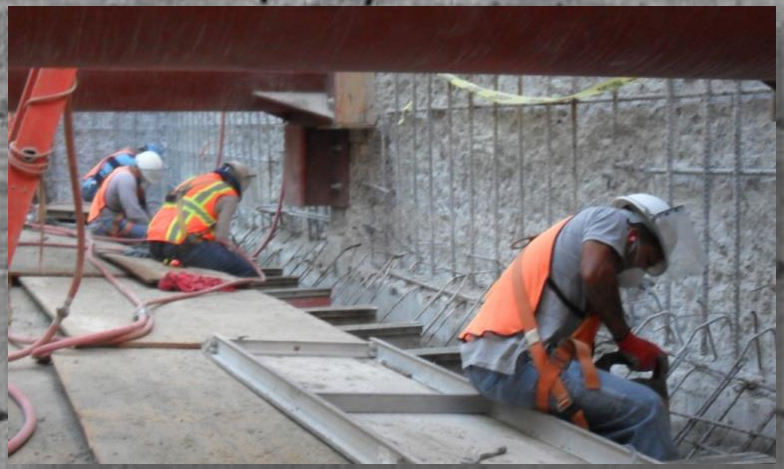
División 3

Especificaciones de Hormigón

CMA, Puente San Antonio, Condado y Condominio Cosmopolitan, Miramar [foto].

En Puerto Rico los materiales y el diseño para producir hormigón son constantes, la diferencia entre un hormigón bueno y uno malo es la forma en que se administran, manejan, mezclan, colocan, prueban y terminan los materiales.

Especificaciones de Hormigón



03 00 00 Concrete

03 01 00 Maintenance of Concrete

03 01 10 Maintenance of Concrete Forming and Accessories
03 01 20 Maintenance of Concrete Reinforcing
03 01 23 Maintenance of Stressing Tendons
03 01 30 Maintenance of Cast-in-Place Concrete

- 03 01 30.51 Cleaning of Cast-in-Place Concrete
- 03 01 30.61 Resurfacing of Cast-in-Place Concrete
- 03 01 30.71 Rehabilitation of Cast-in-Place Concrete
- 03 01 30.72 Strengthening of Cast-in-Place Concrete

03 01 40 Maintenance of Precast Concrete

- 03 01 40.51 Cleaning of Precast Concrete
- 03 01 40.61 Resurfacing of Precast Concrete
- 03 01 40.71 Rehabilitation of Precast Concrete
- 03 01 40.72 Strengthening of Precast Concrete

(2010). MasterFormat 2010 – Update Number & Titles, CSI.

03 10 00 Concrete Forming and Accessories

03 11 00 Concrete Forming

03 11 13 Structural Cast-in-Place Concrete Forming

- 03 11 13.13 Concrete Slip Forming
- 03 11 13.16 Concrete Shoring
- 03 11 13.19 Falsework

03 11 16 Architectural Cast-in Place Concrete Forming

- 03 11 16.13 Concrete Form Liners

03 11 19 Insulating Concrete Forming

03 11 23 Permanent Stair Forming

03 15 00 Concrete Accessories

03 15 13 Waterstops (Banda de PVC)

CMA, Archivo [Foto].

03 20 00 Concrete Reinforcing

03 21 00 Reinforcing Steel

- 03 21 11 Black Steel Reinforcing
- 03 21 13 Galvanized Reinforcing Steel
- 03 21 16 Epoxy-Coated Reinforcing Steel
- 03 21 19 Stainless Steel Reinforcing

03 22 00 Welded Wire Fabric Reinforcing

- 03 22 13 Galvanized Welded Wire Fabric Reinforcing
- 03 22 16 Epoxy-Coated Welded Wire Fabric Reinforcing

03 23 00 Stressing Tendons

03 24 00 Fibrous Reinforcing

03 25 00 Composite Reinforcing

- 03 25 13 Glass Fiber-Reinforced Polymer Reinforcing

CMA (2012). Metro Urbano Bus Rapid Transit & Dynamic Toll Lane, Bayamón. ACT.

03 30 00 Cast-in-Place Concrete

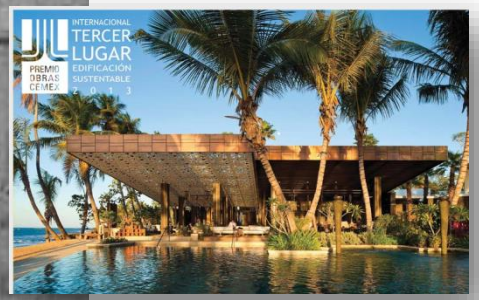
- 03 30 53 Miscellaneous Cast-in-Place Concrete

03 31 00 Structural Concrete

- 03 31 13 Heavyweight Structural Concrete
- 03 31 16 Lightweight Structural Concrete
- 03 31 19 Shrinkage-Compensating Structural Concrete
- 03 31 23 High-Performance Structural Concrete
- 03 31 24 Ultra High-Performance Structural Concrete
- 03 31 26 Self-Compacting Concrete

Especificación mas importante de la División 3

03 33 00	**Architectural Concrete**
03 33 13	Heavyweight Architectural Concrete
03 33 16	Lightweight Architectural Concrete
03 34 00	**Low Density Concrete**
03 35 00	**Concrete Finishing**
03 35 13	High-Tolerance Concrete Floor Finishing
03 35 16	Heavy-Duty Concrete Floor Finishing
03 35 19	Colored Concrete Finishing
03 35 23	Exposed Aggregate Concrete Finishing
03 35 26	Grooved Concrete Surface Finishing
03 35 29	Tooled Concrete Finishing
03 35 33	Stamped Concrete Finishing
03 35 43	Polished Concrete Finishing



CMA (2012). Hotel Ritz Carlton, Dorado . DBR Development Management LLC.

03 37 00 Specialty Placed Concrete

- 03 37 13 Shotcrete
- 03 37 16 Pumped Concrete
- 03 37 19 Pneumatically Placed Concrete
- 03 37 23 Roller-Compacted Concrete
- 03 37 26 Underwater Placed Concrete

03 38 00 Post-Tensioned Concrete

- 03 38 13 Post-Tensioned Concrete Preparation
- 03 38 16 Unbonded Post-Tensioned Concrete
- 03 38 19 Bonded Post-Tensioned Concrete

03 39 00 Concrete Curing

- 03 39 13 Water Concrete Curing
- 03 39 16 Sand Concrete Curing
- 03 39 23 Membrane Concrete Curing
  - 03 39 23.13 Chemical Compound Membrane Concrete Curing
  - 03 39 23.23 Sheet Membrane Concrete Curing

CMA (2007). Tanque 7MG, Patillas-Arroyo. AAA. y USACE (2013). Represa Rio Portugués, Ponce.

03 40 00 Precast Concrete

03 41 00 Precast Structural Concrete

- 03 41 13 Precast Concrete Hollow Core Planks
- 03 41 16 Precast Concrete Slabs
- 03 41 23 Precast Concrete Stairs
- 03 41 33 Precast Structural Pretensioned Concrete
- 03 41 36 Precast Structural Post-Tensioned Concrete

03 45 00 Precast Architectural Concrete

- 03 45 13 Faced Architectural Precast Concrete
- 03 45 33 Precast Architectural Pretensioned Concrete
- 03 45 36 Precast Architectural Post-Tensioned Concrete

CMA (2005). Edificio de Manufactura Microsoft, Humacao . Microsoft Operations Puerto Rico.

03 47 00	**Site-Cast Concrete**
03 47 13	Tilt-Up Concrete
03 47 16	Lift-Slab Concrete
03 48 00	**Precast Concrete Specialties**
03 48 13	Precast Concrete Bollards
03 48 16	Precast Concrete Splash Blocks
03 48 19	Precast Concrete Stair Treads
03 48 33	Precast Pre-Framed Concrete Panels
03 48 43	Precast Concrete Trim
03 49 00	**Glass-Fiber-Reinforced Concrete**
03 49 13	Glass-Fiber-Reinforced Concrete Column Covers
03 49 16	Glass-Fiber-Reinforced Concrete Spandrels
03 49 43	Glass-Fiber-Reinforced Concrete Trim

(2014). Tilt-Up Concrete. Image.

03 60 00 Grouting

- 03 61 00 **Cementitious Grouting** (Mortero a Base de Cemento)
  - 03 61 13 Dry-Pack Grouting
- 03 62 00 **Non-Shrink Grouting**
  - 03 62 13 Non-Metallic Non-Shrink Grouting (Sin Retracción)
  - 03 62 16 Metallic Non-Shrink Grouting
- 03 63 00 **Epoxy Grouting**
- 03 64 00 **Injection Grouting**
  - 03 64 23 Epoxy Injection Grouting

CMA. Archivo [Foto].

03 70 00 Mass Concrete

- 03 71 00 Mass Concrete for Raft Foundations
- 03 72 00 Mass Concrete for Dams

03 80 00 Concrete Cutting and Boring

- 03 81 00 Concrete Cutting
  - 03 81 13 Flat Concrete Sawing
  - 03 81 16 Track Mounted Concrete Wall Sawing
  - 03 81 19 Wire Concrete Wall Sawing
  - 03 81 23 Hand Concrete Wall Sawing
  - 03 81 26 Chain Concrete Wall Sawing
- 03 82 00 Concrete Boring
  - 03 82 13 Concrete Core Drilling

CMA (1999). Torre Cardón, San Juan.

07

Certificados

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Certificado CDT

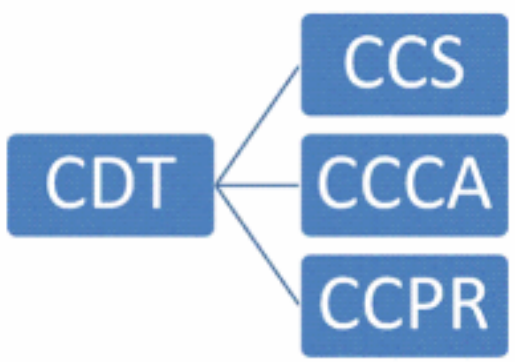
Como **CDT** "*Construction Document Technologist*", tiene entendimiento conceptual del proceso de construcción:

- Desarrollar y administrar documentos de construcción
- Escribir y aplicar especificaciones
- Investigar productos
- Comunicarse con equipos de diseño y construcción

CSI tiene 3 programas más

Ser CDT es pre-requisito para obtener las siguientes:

- **CCS** Certified Construction Specifier
- **CCCA** Certified Construction Contract Administrator
- **CCPR** Certified Construction Product Representative



Más información: csinet.org

08

Referencias

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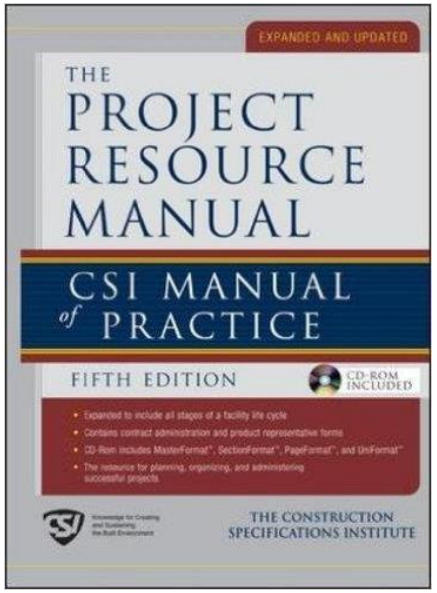
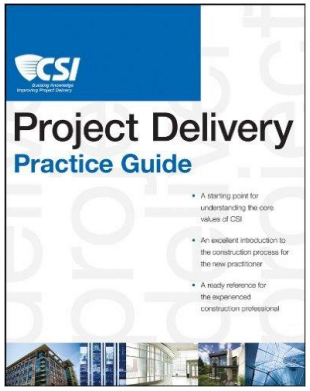
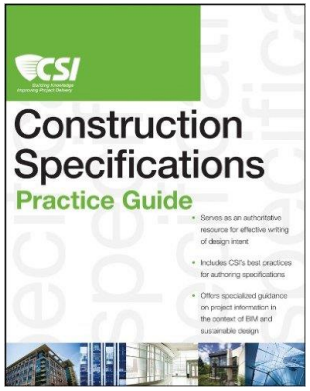
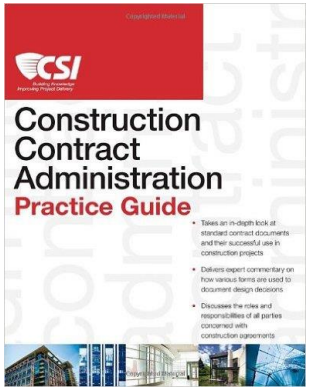
Libros publicados por CSI

- Project Resource Manual (PRM)
- Practice Guides in 2008
  - Project Delivery
  - Construction Specifications
  - Contract Administration









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09

Editando Especificaciones

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Especificaciones "Master"

- 2 maneras de escribir especificaciones:
  - *"From stratch"*
  - Con texto pre-escrito llamado "Master"
- "Master Specifications" sirve de guía e incluye <u>sugerencias para editar.</u> Es el método mas usado por firmas A/E.
  - *"Office Master"*
  - Producto comercial $

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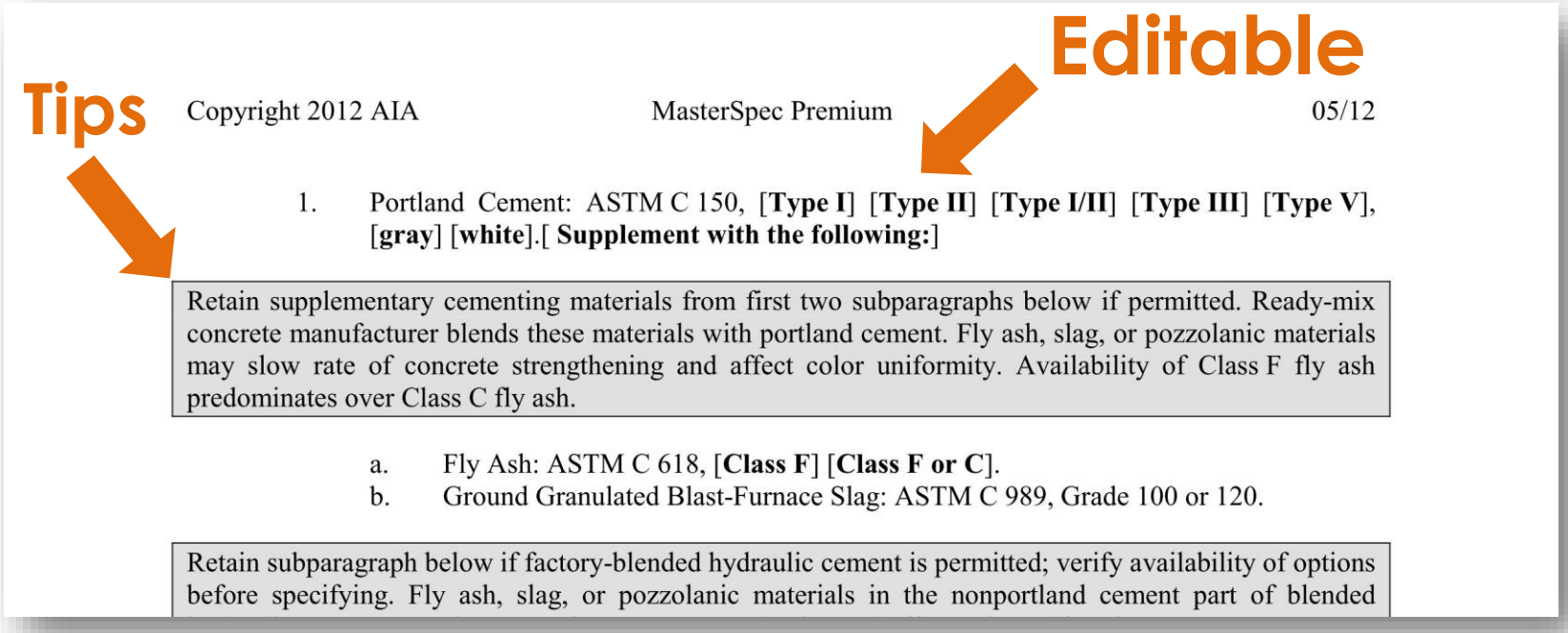

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SECTION 033000 - CAST-IN-PLACE CONCRETE

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

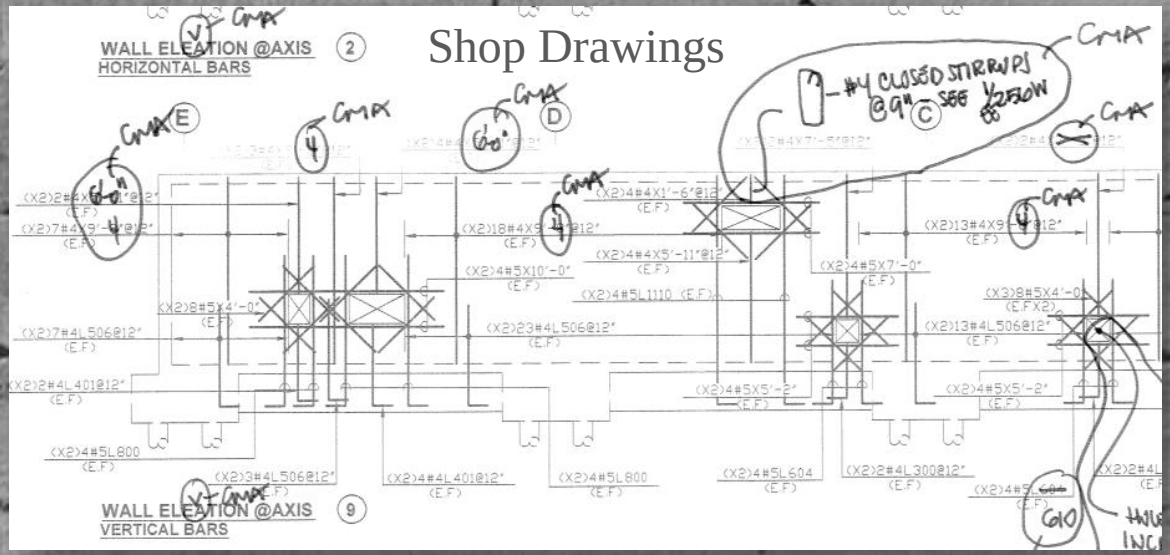
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

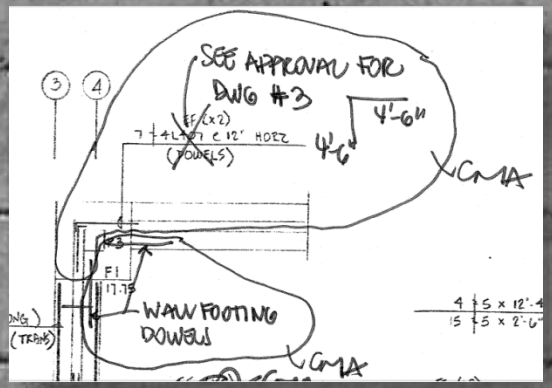
C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

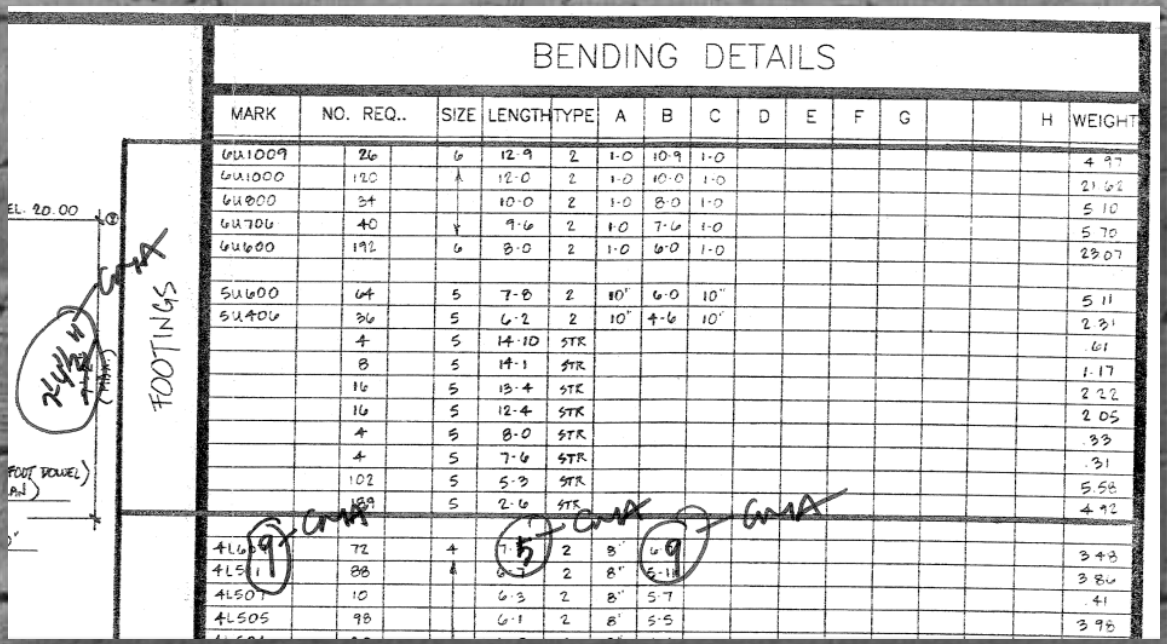
1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

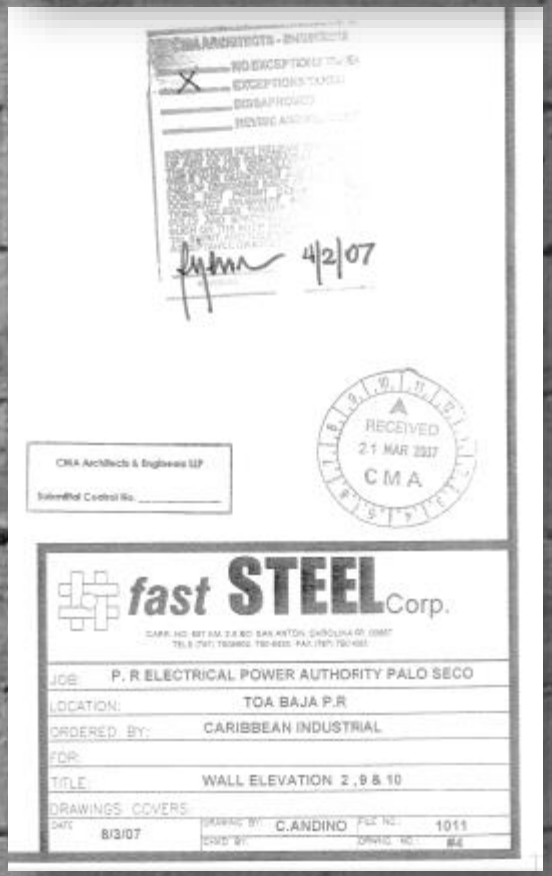
Shop Drawings







MARK	NO. REQ..	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	WEIGHT
6U1009	26	6	12-9	2	1-0	10-9	1-0						4 97
6U1000	120	6	12-0	2	1-0	10-0	1-0						21 62
6U800	34	6	10-0	2	1-0	8-0	1-0						5 10
6U706	40	6	9-6	2	1-0	7-6	1-0						5 70
6U600	192	6	8-0	2	1-0	6-0	1-0						23 07
5U600	64	5	7-8	2	10"	6-0	10"						5 11
5U406	36	5	6-2	2	10"	4-6	10"						2 31
	4	5	14-10	STR									.61
	8	5	14-1	STR									1-17
	16	5	13-4	STR									2 22
	16	5	12-4	STR									2 05
	4	5	8-0	STR									.33
	4	5	7-6	STR									.31
	102	5	5-3	STR									5 58
	139	5	2-6	STR									4 92
4L6	72	4	7-5	2	8"	6-9							3 48
4L5	88	4	6-7	2	8"	5-11							3 80
4L507	10		6-3	2	8"	5-7							.41
4L505	98		6-1	2	8"	5-5							3 98



Design Mixture

promix
LOS PROFESIONALES DEL CONCRETO

Professional Ready Mix, Inc.

Concrete Mix Design Submittal

NRMCA
CERTIFIED PLANT

DATE 10/28/2013
CONTRACTOR CAGUAS MECHANICAL
PROYECTOS PALL
LOCATION FAJARDO
MIX DESCRIPTION 4000 PSI REG MIX SLUMP 6" W/C 0.45

MIX ID 946
MIX NO. 212-40063XGE45
PLANT CEIBA 2
STRUCTURE ESTRUCTURAS

MIX TYPE REGULAR
REMARKS 1.5 LB/YD MICROFIBER+ 1.5 GAL/YD ECLIPSE
REQ STRENGTH 4000 PSI

SLUMP 6.00 in
SLUMP TOLERANCES +/- 1.50 in
EXTENDED TIME 1.5 hr

CEMENTITIOUS			**QTY**
	CEMEX PR SLAG		660 LB
WATER			
	WATER	36 GAL	300 LB
AGGREGATES			
COARSE	ORIENTAL SAND & GRAVEL BASALT ASTM C33 Size 57 (1 IN TO NO 4)		1340 LB
INTERMEDIATE	ORIENTAL SAND & GRAVEL BASALT ASTM C33 SIZE 89 (3/8 IN TO NO 16		320 LB
FINE			0
	ORIENTAL SAND & GRAVEL NATURAL SAND ASTM C33		1299 LB

ADMIXTURES

ECLIPSE	SHRINKAGE REDUCING ASTM C494 TYPE S	WR GRACE	1.5	GAL/YD	1.5	GAL/YD
MICROFIBER	SYNTHETIC FIBER	WR GRACE	1.5	LB/YD	1.5	LB/YD
ADVA 190	HR WATER REDUCER ASTM C494 TYPE F	WR GRACE	6	OZ/CW	39.6	OZ/YD
WRDA 60	WATER REDUCER ASTM C494 TYPE A	WR GRACE	9	OZ/CW	59.4	OZ/YD

PROPERTIES

W/CT RATIO	0.45
TOTAL AGGREGATES (LBS)	2959
SAND/AGGREGATES	0.44
% AIR	2.00%
YIELD (CFT)	27.0
UNIT WEIGHT (PCF)	145.1

SUBMITTED BY:

PEDRO J. RIVERA, BSCE
QC MANAGER

This mix design has been created by Professional Ready Mix, Inc. for the customer named above. It shall be used specifically for the above customer and their named project only by Professional Ready Mix, Inc. This design is the sole property of Professional Ready Mix, Inc., in perpetuity. Any use without permission will be deemed illegal with action taken accordingly.

CMA ARCHITECTS & ENGINEERS LLP

_____ NO EXCEPTIONS TAKEN

_____ EXCEPTIONS TAKEN

_____ DISAPPROVED

✓ REVISE AND RESUBMIT

REVIEW DOES NOT RELIEVE CONTRACTOR OF ANY OF HIS RESPONSIBILITIES UNDER THE CONTRACT. CONTRACTOR IS RESPONSIBLE FOR QUANTITIES AND DIMENSIONS AND OF CHECKING SAME AT THE SITE. IT DOES NOT PERMIT DEPARTURE FROM CONTRACT DRAWING AND SPECIFICATIONS UNLESS THESE DEVIATIONS ARE FULLY AND SPECIFICALLY INDICATED AS SUCH ON THE SHOP DRAWING OR SUBMITTAL SHEET AND THE ARCHITECT-ENGINEER ACCEPTANCE GRANTED IN WRITING.

REVIEWER 10/4/05 DATE

Project: Microsoft Operations Puerto Rico LLC Humacao, Puerto Rico
New Manufacturing Facilities

Submittal No.: 3-4A: Regular Concrete Mix Design 3,000 PSI, 4" Slump & 0.50 W/C
(Building Foundations) Re-Submittal

1. ACTUAL FINE AGGREGATE CONTENT IS 0.488 BY WEIGHT OF THE TOTAL AGGREGATE CONTENT. FINE AGGREGATE CONTENT SHALL BE 35% TO 45% BY WEIGHT OR VOLUME OF THE TOTAL AGGREGATE CONTENT.
2. YOUR SUBMITTAL DOES NOT CONTAIN THE FOLLOWING
   - MILL TEST OF CEMENT
3. WHY ARE YOU USING MANUFACTURED SAND ? MANUFACTURED SAND.
4. LIMITS FOR SIEVES No. ... TO ... AND ... TO ... PASSING CORNER.

CMA ARCHITECTS & ENGINEERS LLP

_____ NO EXCEPTIONS TAKEN

_____ EXCEPTIONS TAKEN

_____ DISAPPROVED

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REVIEWER 10/4/05 DATE

1.7 QUALITY ASSURANCE

E. Mockups: Cast concrete [**slab-on-grade**] [**and**] [**formed-surface**] panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately [**200 sq. ft. (18.6 sq. m) for slab-on-grade**] [**and**] [**100 sq. ft. (9.3 sq. m) for formed surface**] <**Insert area**> in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2.3 STEEL REIFORCEMENT

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

E. Epoxy-Coated Reinforcing Bars: [**ASTM A 615/A 615M, Grade 60 (Grade 420)**] [**ASTM A 706/A 706M**], deformed bars, [**ASTM A 775/A 775M**] [**or**] [**ASTM A 934/A 934M**], epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

F. Stainless-Steel Reinforcing Bars: ASTM A 955/A 955M, Grade 60 (Grade 420), [**Type 304**] [**Type 316L**], deformed.

2.4 REIFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

CMA (2005). Edificio de Manufactura Microsoft, Humacao . Microsoft Operations Puerto Rico.

2.5 CONCRETE MATERIALS

C. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, **[Type I] [Type II] [Type I/II] [Type III] [Type V]**, **[gray] [white]**.
2. Fly Ash: ASTM C 618, **[Class F] [Class F or C]**.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595/C 595M, **[Type IS, portland blast-furnace slag] [Type IP, portland-pozzolan] [Type IL, portland-limestone] [Type IT, ternary blended]** cement.
5. Silica Fume: ASTM C 1240, amorphous silica.

CMA (2003). Grain Silos, Guaynabo. Panamerican Grain.

2.5 CONCRETE MATERIALS

D. Normal-Weight Aggregates: ASTM C 33/C 33M, **[Class 3S] [Class 3M] [Class 1N] <Insert class>** coarse aggregate or better, graded. Provide aggregates from a single source[**with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials**].

1. Maximum Coarse-Aggregate Size: **[1-1/2 inches (38 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] <Insert dimension>** nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

CMA (2003). Grain Silos, Guaynabo. Panamerican Grain.

H. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

Grace Concrete Products

GRACE

DCI® S
Corrosion inhibitor

Product Description

DCI® S Corrosion Inhibitor is a liquid added to concrete during the batching process. It chemically inhibits the corrosive action of chlorides on reinforcing steel and prestressed strands in concrete. DCI S has been formulated to provide set time characteristics similar to untreated concrete at 72°F (22°C). One gallon of DCI S weighs approximately 10.7 lbs (one liter of DCI weighs approximately 1.28 kg ± 0.01 kg). DCI S contains a

Uses

DCI S is recommended for all steel-reinforced, post tensioned and prestressed concrete that will come in contact with chlorides from de-icing salts or a marine environment. Examples are parking garage decks and support structures, bridge decks and prestressed members, and structures in marine environments. It may also be used in concrete where chlorides are added during manufacture.

(2014). www.dmireadymix.com. Grace Concrete Products.

2.6 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 1, cold-drawn wire, deformed, minimum of [**1.5 inches (38 mm)**] [**2 inches (50 mm)**] [**2.4 inches (60 mm)**] <**Insert dimension**> long, and aspect ratio of [**35 to 40**] [**45 to 50**] [**60 to 65**] <**Insert ratio**>.

C. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, [**1/2 to 1-1/2 inches (13 to 38 mm)**] [**1 to 2-1/4 inches (25 to 57 mm)**] <**Insert dimensions**> long.

(2014). http://www.tgrmcc.com. Transgulf Ready-mix Concrete Company Ltd.

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A[**, except with maximum water-vapor permeance of <Insert rating>**]. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.11 CURING MATERIALS

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: **[5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength> [As indicated]** at 28 days.
2. Maximum W/C Ratio: **[0.50] [0.45] [0.40] <Insert number>**.
3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] [8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture] <Insert dimension>**, plus or minus 1 inch (25 mm).

Table 2: Water-cement ratio vs. compressive strength

28-day compressive strength	Water-cement ratio, by mass: Non-air-entrained concrete	Water-cement ratio, by mass: Air-entrained concrete
6000	0.41	–
5000	0.48	0.40
4000	0.57	0.48
3000	0.68	0.59
2000	0.82	0.74

Based on Table 6.3.4(a) in ACI 211.1

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).

CMA (2003). Grain Silos, Guaynabo. Panamerican Grain.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

CMA (2003). Grain Silos, Guaynabo. Panamerican Grain.

3.9 CONCRETE PLACEMENT

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

CMA (2003). Grain Silos, Guaynabo. Panamerican Grain.

3.9 CONCRETE PLACEMENT

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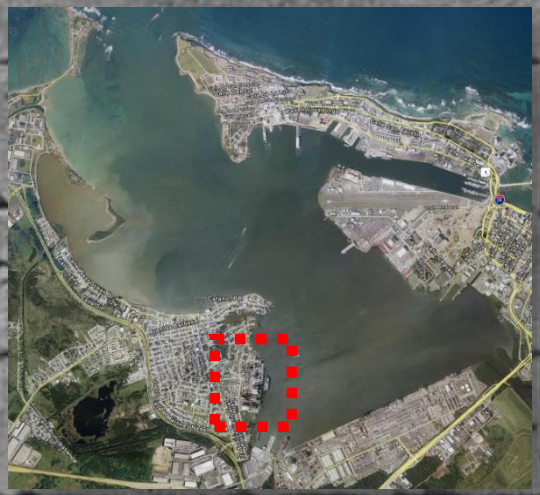

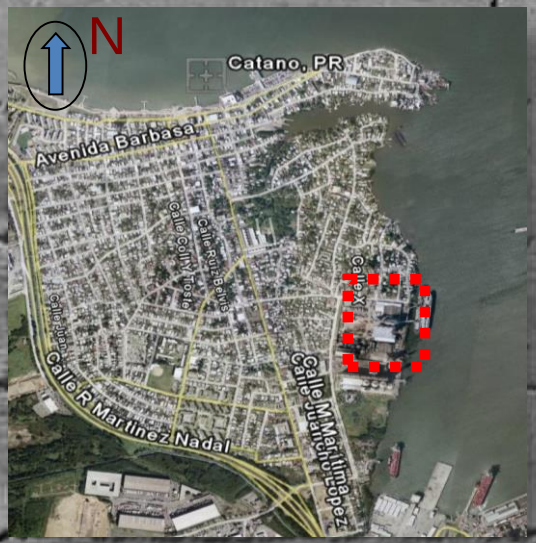

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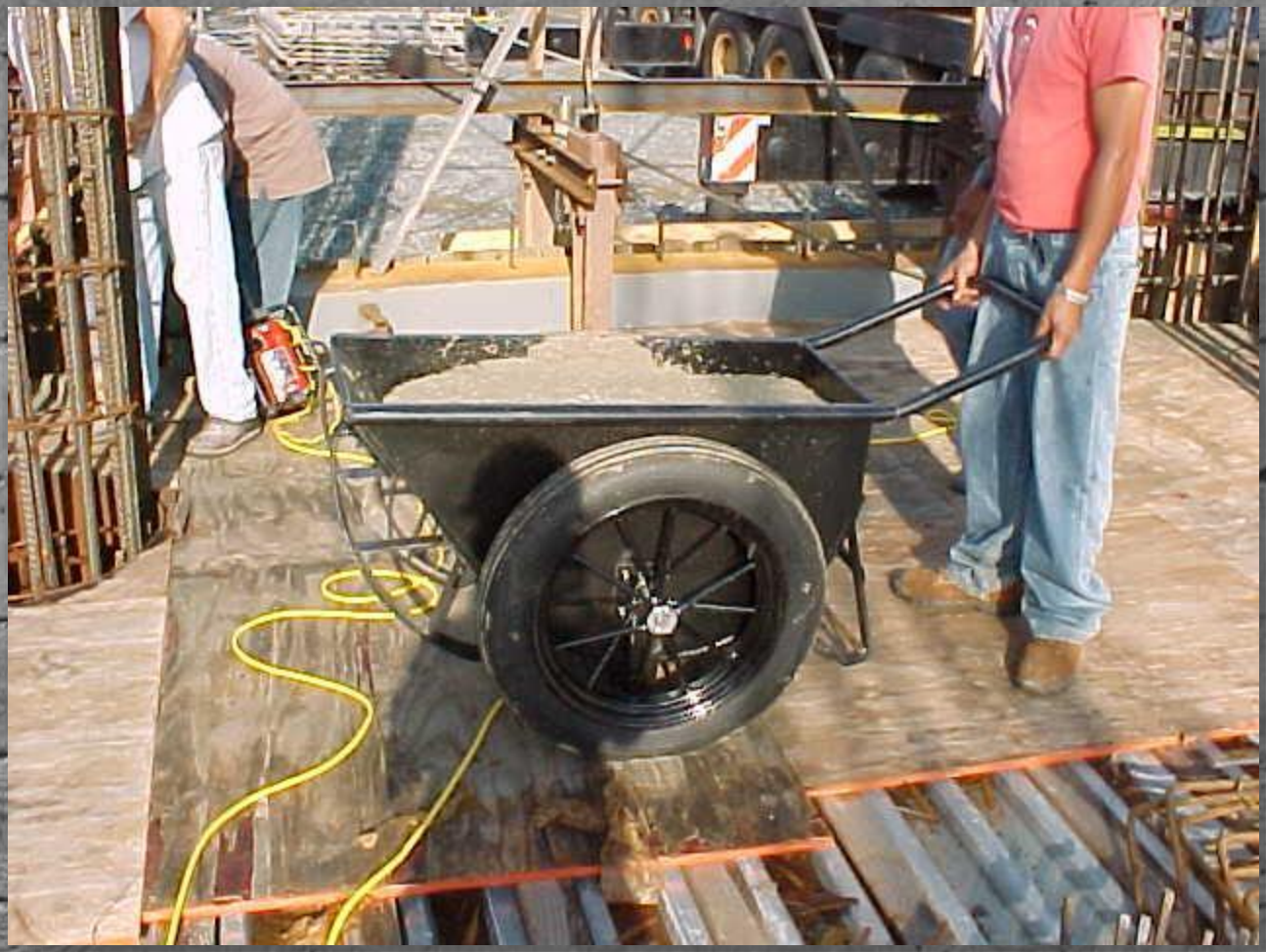

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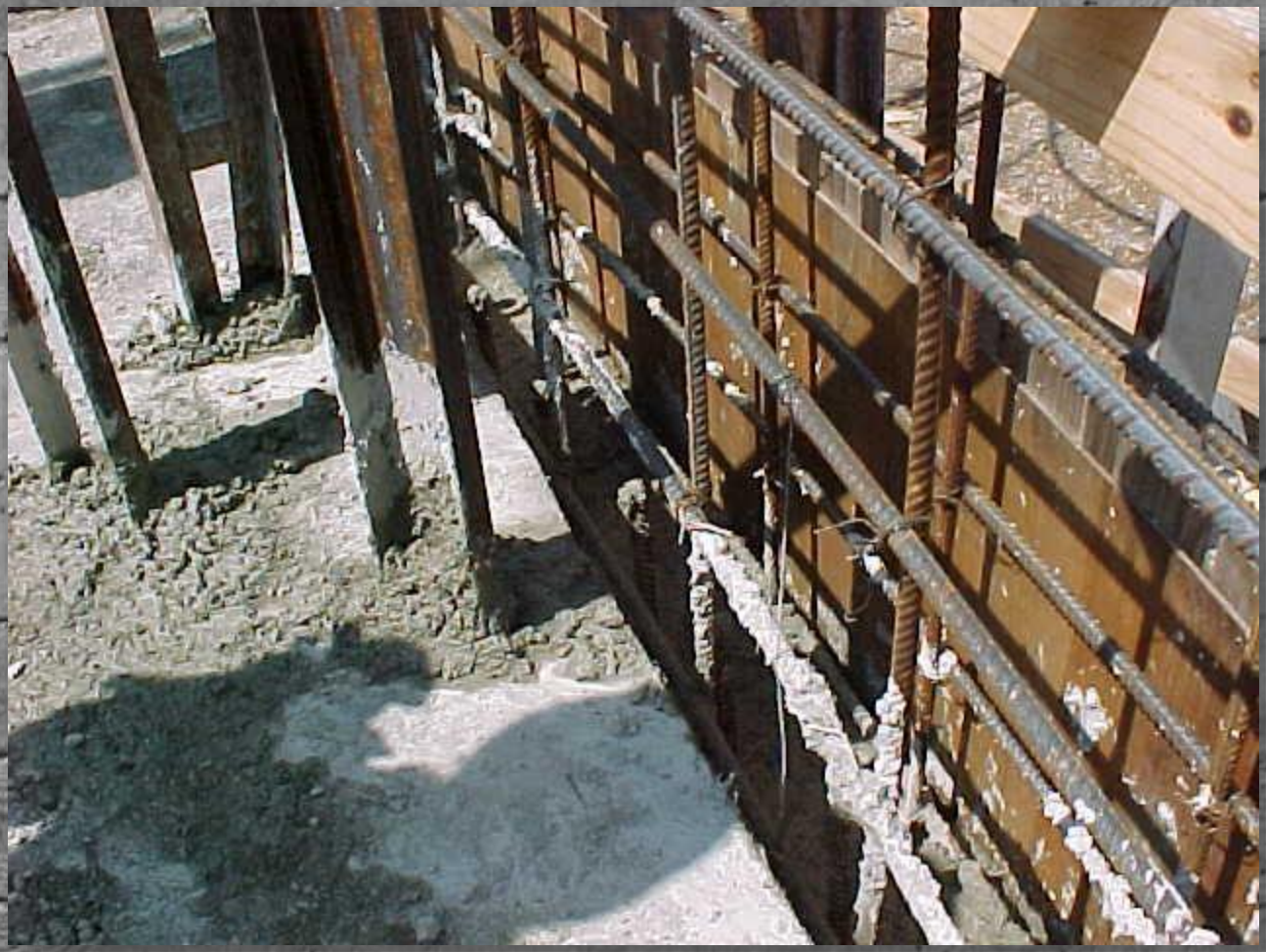

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- Concrete pour for the job ~ 12,000 yd^3
- Slip form operation 137-ft in 12-days at 6-in./hr.
- Personal during slip form operation ~ 150 people at platform per 12 hour shifts
- Inspectors during slip form operation ~ 12 people at platform per 12 hour shifts

Preguntas

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thank you!

Gracias

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