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An Overview of Construction Engineering



AUB American University of Beirut
الجامعة الأميركية في بيروت

Agenda

- Intro. to Construction engineering
- Future Trends in Construction
- Real life construction projects
 - Rose Tower
 - Burj Khalifa





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- Cathedral Hill Hospital Project
- \$ 1.7 Billion in San Francisco
- 555 Beds
- 912,000 SF



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Academic Experience:

Assistant Professor, Department of Construction Management
Colorado State University
2009-2011

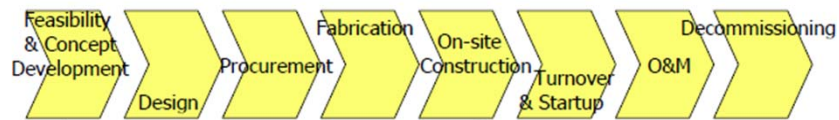
What is Construction Engineering?

- Construction engineering is a **specialized branch of civil engineering** concerned with planning, management, execution and control of construction operations for projects such as highways, bridges, airports, railroads, buildings, dams, and reservoirs.
- Construction of such projects requires knowledge of:
 - Engineering principles
 - Management principles and Business procedures



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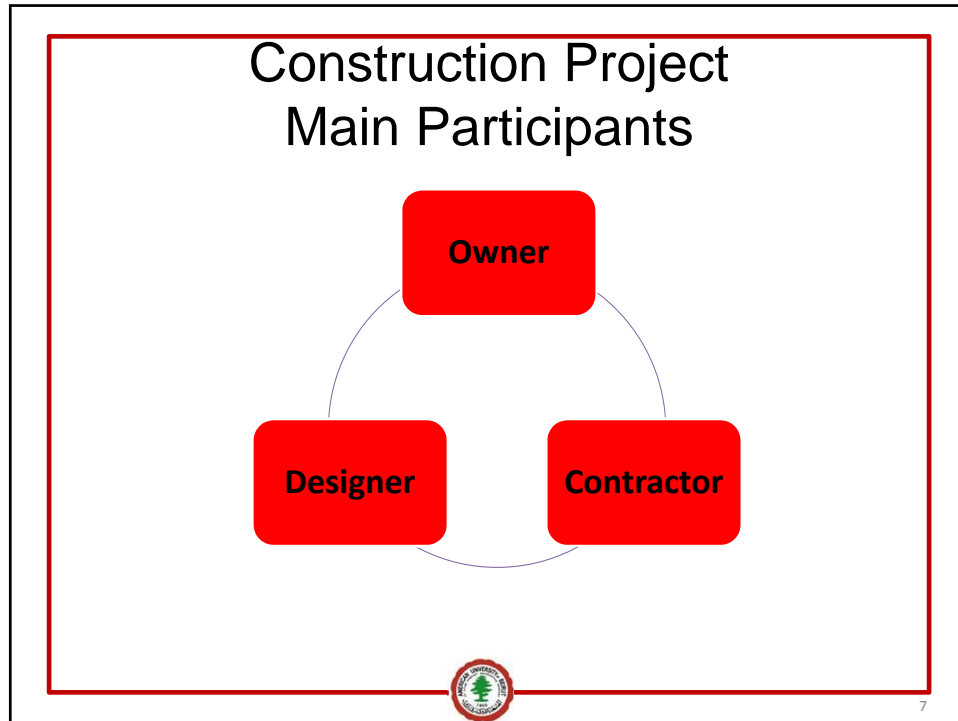
Construction



What are the different types of construction projects?

- Building construction
- Heavy / civil construction
- Industrial construction

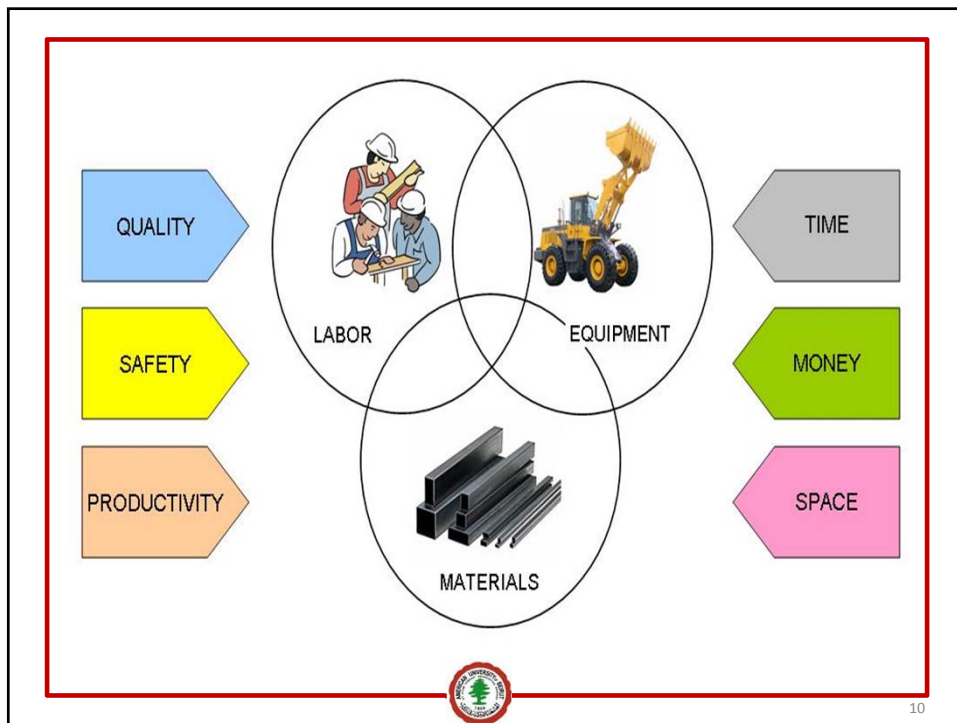




- ## Who's involved?
- Owner
 - You and I = the Public
 - Architects, Designers, and Engineers
 - General Contractors and Specialty Contractors
 - Fabricators
 - Manufacturers
 - Raw Materials Suppliers
 - Shipping Agents, Distributors
 - Training Facilities (union and non-union), etc.
-
- The slide lists various stakeholders involved in a construction project. At the bottom center is a small circular logo with a tree and the text 'UNIVERSITY OF CALIFORNIA' and '1868'.

Project KPI's

Key Performance Indicators



Why ConsE Program at AUB?

- 60% of CEE graduates end up working in contracting companies
- Why not then prepare our students from school to work in **CONTRACTING** companies?



Construction Engineering Sequence

Specialization in construction engineering is ideal if you are looking for fast-paced job opportunities in construction.



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So What Do You Learn Here at AUB?

In the **ConsE program** here at AUB, besides basic civil engineering knowledge, you learn mainly 2 functional levels of construction engineering:

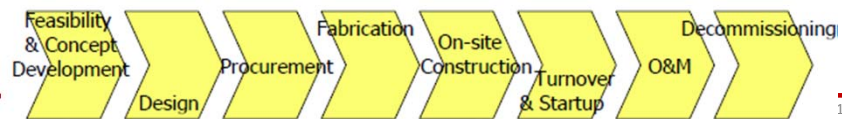
- (1) The Construction Project
- (2) Construction Operations



I- The Construction Project

•How to estimate, bid, plan, schedule, control and manage a project at a profit, including:

- Contract negotiations
- Material selection and purchasing
- Labor relations
- Equipment Selection
- Subcontract procurement and coordination
- Detailed Cost estimates
- Quality assurance
- Accounting
- Scheduling
- Cost control



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Construction Project Typical Challenges

Delays

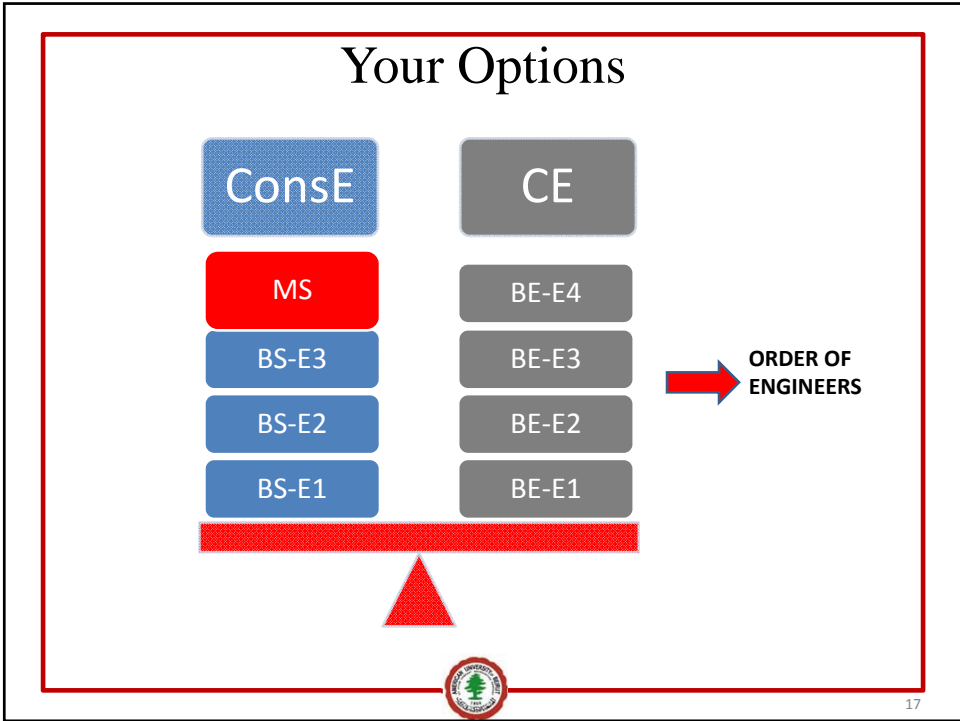




II- Construction Operations

- How to plan and supervise construction operations including:
 - Crew selection and training
 - Equipment selection and maintenance
 - Material selection, fabrication, and installation (latest technologies)
 - Measure and analyze operations to improve productivity and safety
 - Etc.





Construction Daily Report

Project: I-57 Overpass Bridge Expansion
 Date: 3/25/00
 Inspector: Steve Reynolds
 Weather: Cloudy, L@40,H@5

Contractors on Site:
 1. Butler Concrete 4.
 2. CLRE Testing 5.
 3. Harco Const. 6.

Progress of the Day:
 Rebars for railing, north side 50%
 Deck concrete demolition/prepara
 Joint drainage & waterproofing

Manpower Record:
 Crews: carp(6), iron(3), labr(2)

Construction Daily Report

Daily Reports:

3/25/00 [Image] [Image] [Image] [Image] [Image] [Image]

3/26/00 [Image] [Image] [Image] [Image] [Image] [Image]

3/27/00 [Image] [Image] [Image] [Image] [Image] [Image]



Link assemblies in CAD Mapper

Create assemblies in PE

Create estimate in CAD Integrator

BIM model – cost integration

Assembly	Phase	Description	Quantity	Unit	Unit Price	Material Amount	Material Price	Material Amount	Total Cost	Total Amount
1100	1100	Shop forms and panels (M)	1,200.00	sq ft	3.00	3,600.00	3.00	3,600.00	3,600.00	3,600.00
1100	1100	Column forms (M)	1,200.00	sq ft	4.00	4,800.00	4.00	4,800.00	4,800.00	4,800.00
1100	1100	Concrete (2000 psi) (pump) (C)	1,200.00	cu yd	40.00	48,000.00	40.00	48,000.00	48,000.00	48,000.00
1100	1100	Rebar (M)	1,200.00	lb	1.00	1,200.00	1.00	1,200.00	1,200.00	1,200.00
1100	1100	Form release (C)	1,200.00	sq ft	0.05	60.00	0.05	60.00	60.00	60.00
1100	1100	Shop forms and panels (M)	1,200.00	sq ft	2.00	2,400.00	2.00	2,400.00	2,400.00	2,400.00
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1100	1100	Form release (C)	1,200.00	sq ft	0.05	60.00	0.05	60.00	60.00	60.00





- Are you engineers or imagineers?
- <http://www.youtube.com/watch?v=nE8PvsRqjkg&noredirect=1>



So what's new?

- <http://www.youtube.com/watch?v=szM5u7vSuQI&feature=relmfu&noredirect=1>



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REAL-LIFE CONSTRUCTION PROJECTS



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Rose Tower (Dubai)

- Owner: Rotana hotel chain
- Contractor: ACC
- 333 m high (1,093 ft)
- 72 floors
- Highest hotel apartment building
- The most slender building (1-9 structural, 1-11 overall)
- Foot print 30 x 30 sq. m (~100 x 100 sq. ft)
- Strange Window Cleaning system (animation)



#	Building	City	Height	Height	Floors	Year
1.	Taipei 101	Taipei	509 m	1,671 ft	101	2004
2.	Shanghai World Financial ...	Shanghai	492 m	1,614 ft	101	2008
3.	Petronas Tower 1	Kuala Lumpur	452 m	1,483 ft	88	1998
4.	Petronas Tower 2	Kuala Lumpur	452 m	1,483 ft	88	1998
5.	Sears Tower	Chicago	442 m	1,451 ft	108	1974
6.	Jin Mao Tower	Shanghai	421 m	1,380 ft	88	1999
7.	Two International Finance...	Hong Kong	415 m	1,362 ft	88	2003
8.	CITIC Plaza	Guangzhou	391 m	1,283 ft	80	1997
9.	Shun Hing Square	Shenzhen	384 m	1,260 ft	69	1998
10.	Empire State Building	New York City	381 m	1,250 ft	102	1931
11.	Central Plaza	Hong Kong	374 m	1,227 ft	78	1992
12.	Bank of China Tower	Hong Kong	367 m	1,205 ft	70	1990
13.	Bank of America Tower	New York City	366 m	1,200 ft	54	2008
14.	Almas Tower	Dubai	380 m	1,181 ft	74	2008
15.	Emirates Office Tower	Dubai	355 m	1,163 ft	54	2000
16.	Tuntex Sky Tower	Kaohsiung	348 m	1,140 ft	85	1997
17.	Aon Center	Chicago	346 m	1,136 ft	83	1973
18.	The Center	Hong Kong	346 m	1,135 ft	73	1998
19.	John Hancock Center	Chicago	344 m	1,127 ft	100	1969
20.	Rose Tower	Dubai	333 m	1,093 ft	72	2007

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Official World's 100 Tallest High-rise Buildings (Hotel Use)

This overview is the most accurate compilation of its kind and uses in-depth research results and reliable building information. It is based on data standards as outlined by the Emporis Standards Committee (ESC). This listing is verified and updated continuously and includes high-rise buildings which have been topped out, including those still under construction or on hold and whose occupiable height is devoted at least 90% to hotel uses. The ranking is based entirely on the buildings' structural height. TV towers, masts, and other building types are not included.

#	Building	City	Height	Height	Floors	Year
1.	Rose Tower	Dubai	333 m	1,093 ft	72	2007
2.	Ryugyong Hotel	Pyongyang	330 m	1,083 ft	105	1992
3.	Buri Al Arab	Dubai	321 m	1,053 ft	60	1999
4.	Jumeirah Emirates Towers	Dubai	309 m	1,014 ft	56	2000
5.	Baiyoke Tower II	Bangkok	304 m	997 ft	85	1997
6.	The Cullinan I	Hong Kong	270 m	886 ft	68	2008
7.	Grand Lisboa	Macao	258 m	846 ft	52	2008
8.	Lanko-Grand Hyatt Hotel	Chongqing	258 m	846 ft	60	2004
9.	Oasis Skyway Garden Hotel	Shanghai	226 m	742 ft	52	2007
10.	JR Central Hotel Tower	Nagoya	226 m	741 ft	53	2000
11.	Swissôtel The Stamford	Singapore	226 m	741 ft	73	1986
12.	Detroit Marriott at the R	Detroit	221 m	727 ft	70	1977
13.	Westin Peachtree Plaza	Atlanta	220 m	723 ft	73	1976
14.	Ritz-Carlton Jakarta Towe	Jakarta	212 m	696 ft	48	2005
15.	Ritz-Carlton Jakarta Towe	Jakarta	212 m	696 ft	48	2005

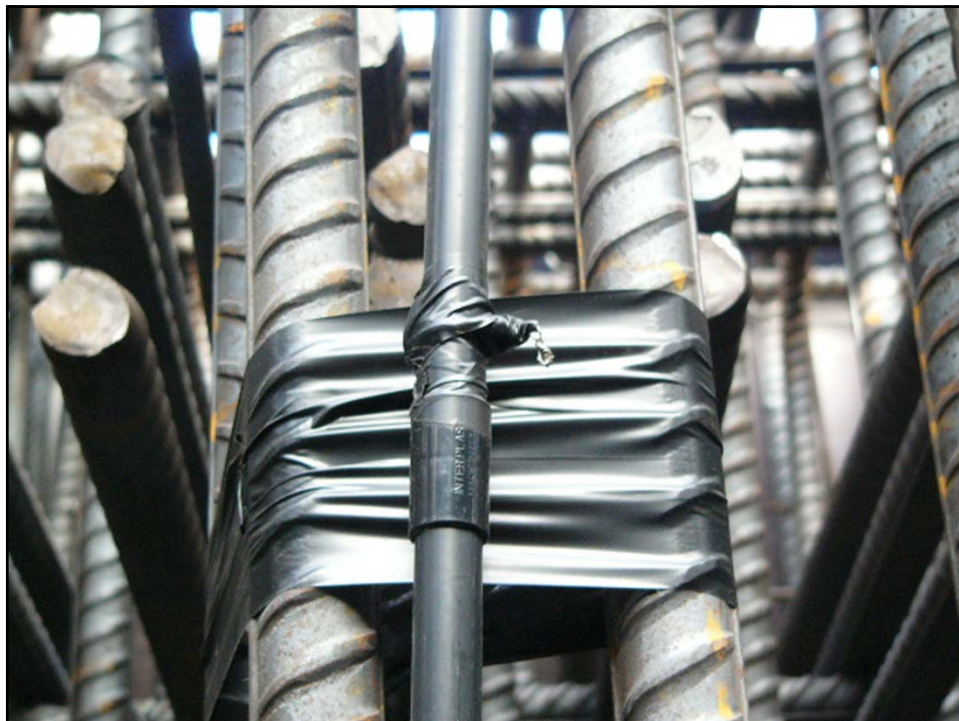
Structural Statistics

- 4000 Cu m for a 4.4 m deep raft foundation
- 1200 tons of reinforced in the Raft
- 40,000 Cu. m of concrete
- 6000 tons of Structural steel
- 8000 tons of reinforced steel



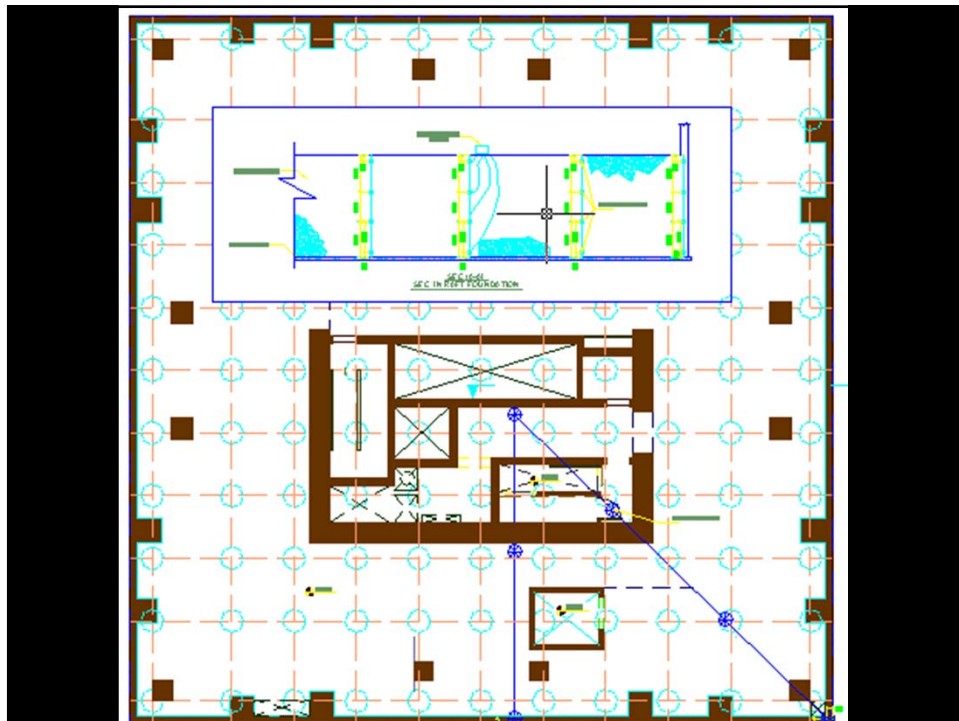
Raft foundation Challenges

- Concrete temperature control
- Rebar congestion
- Access Logistics



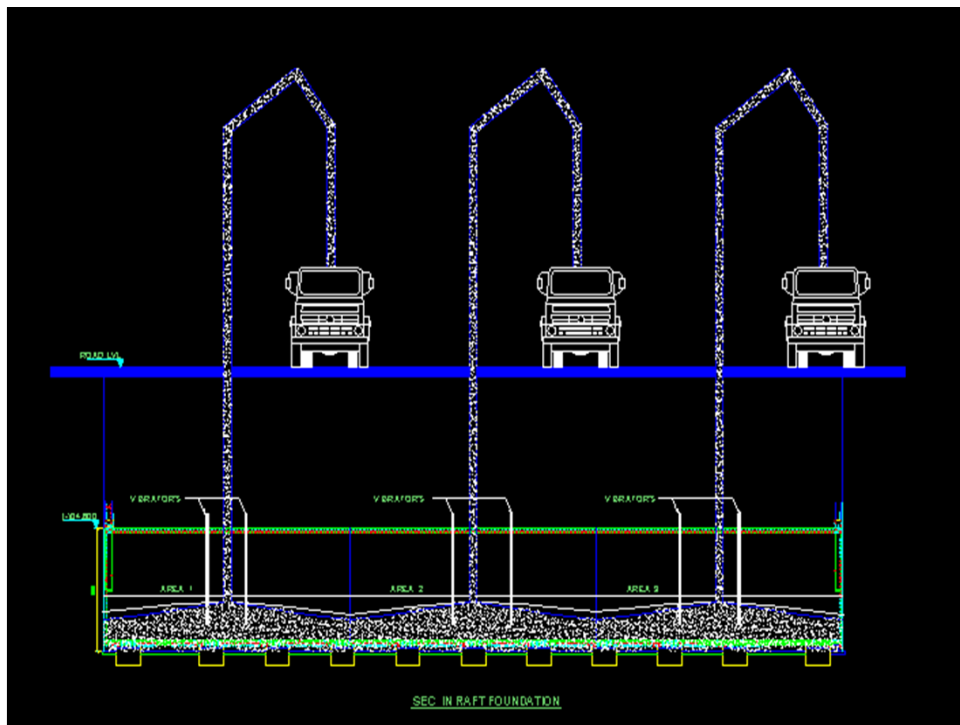
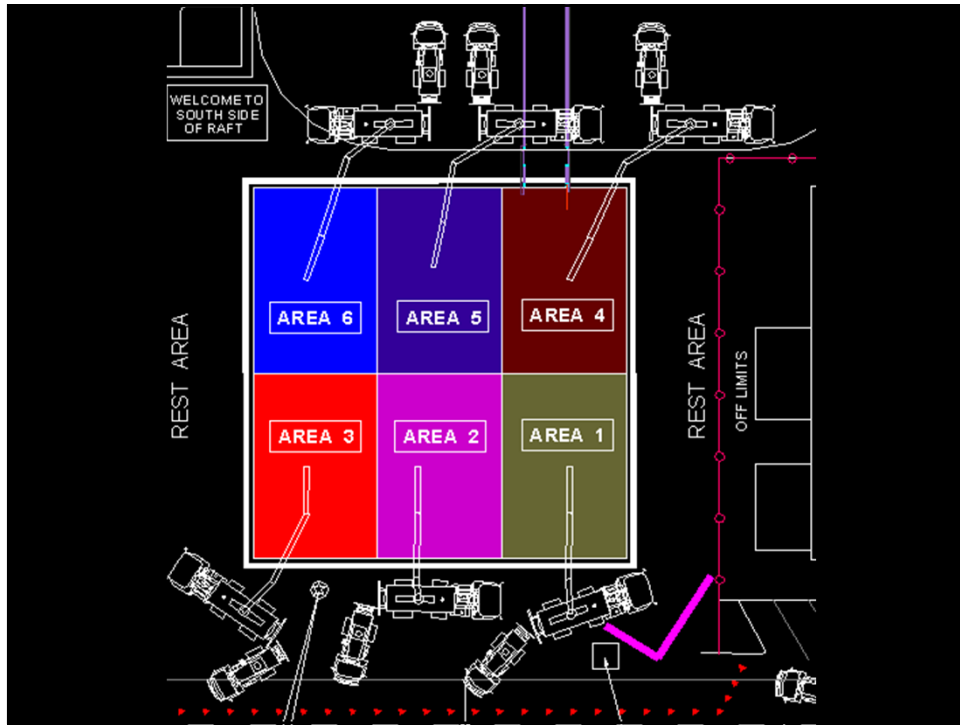
Temperature control

- Difference between any two points in the raft should be less than 25-30 degrees Centigrade.
- Difference between the concrete surface and outside air temperature should be less than 25-30 degrees Centigrade



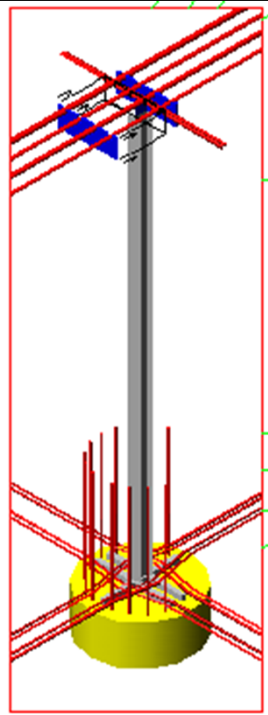


Pour Logistics



Rebar Congestion

- Used non conventional rebar chairs
- Two different concrete mixes for near rebar and away from rebar layers









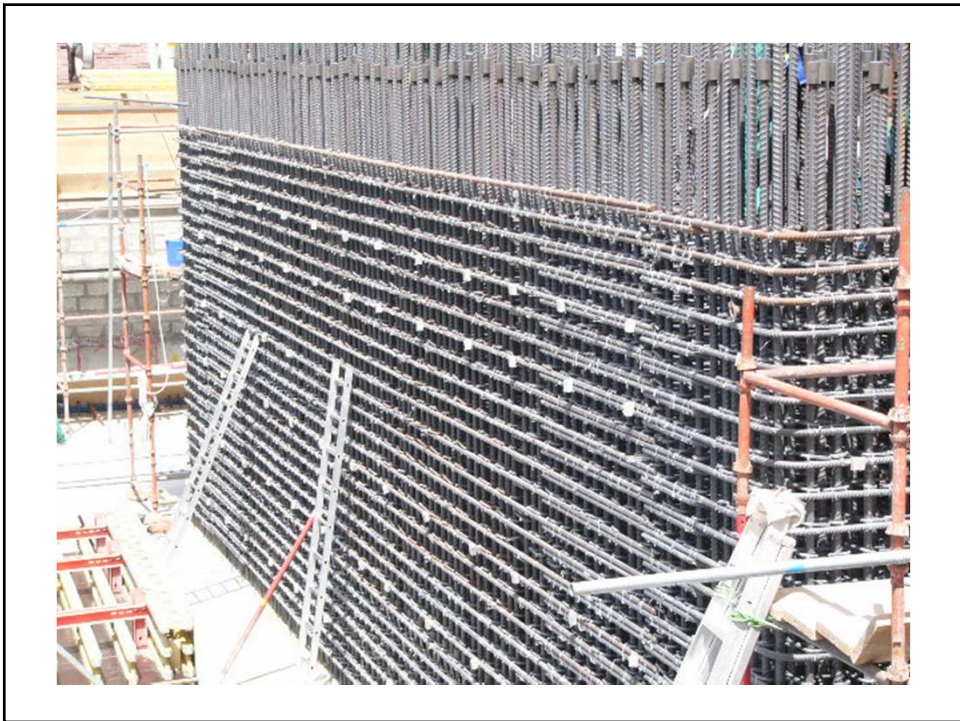
Superstructure Issues

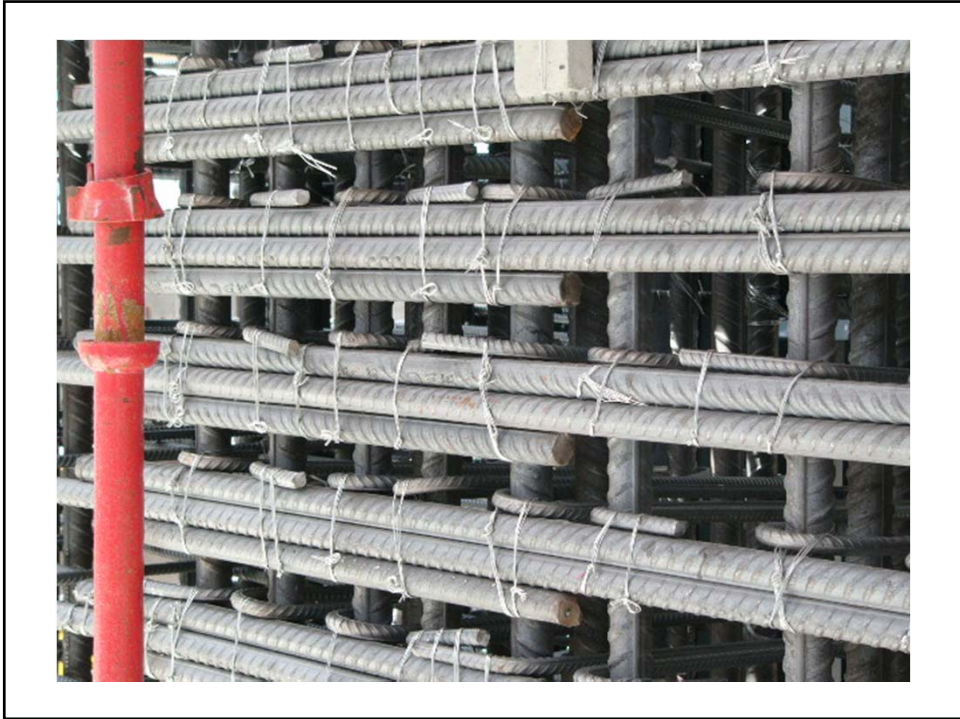
Formwork Systems

- Traditional
- Self Climbing
 - Slip form
 - Jump form

What is wrong?



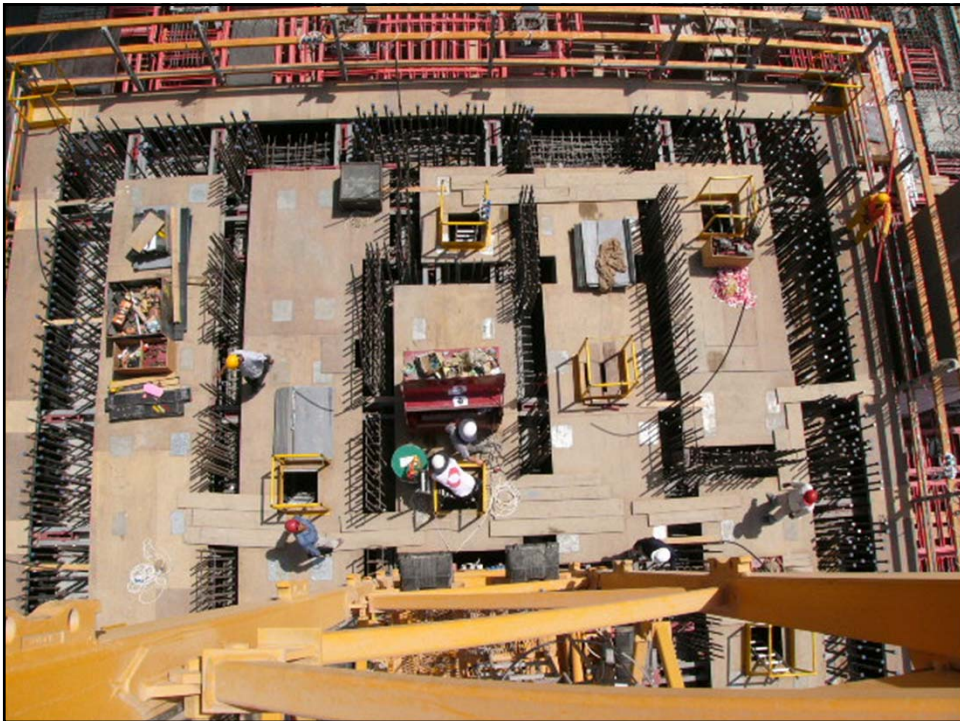




Jump form

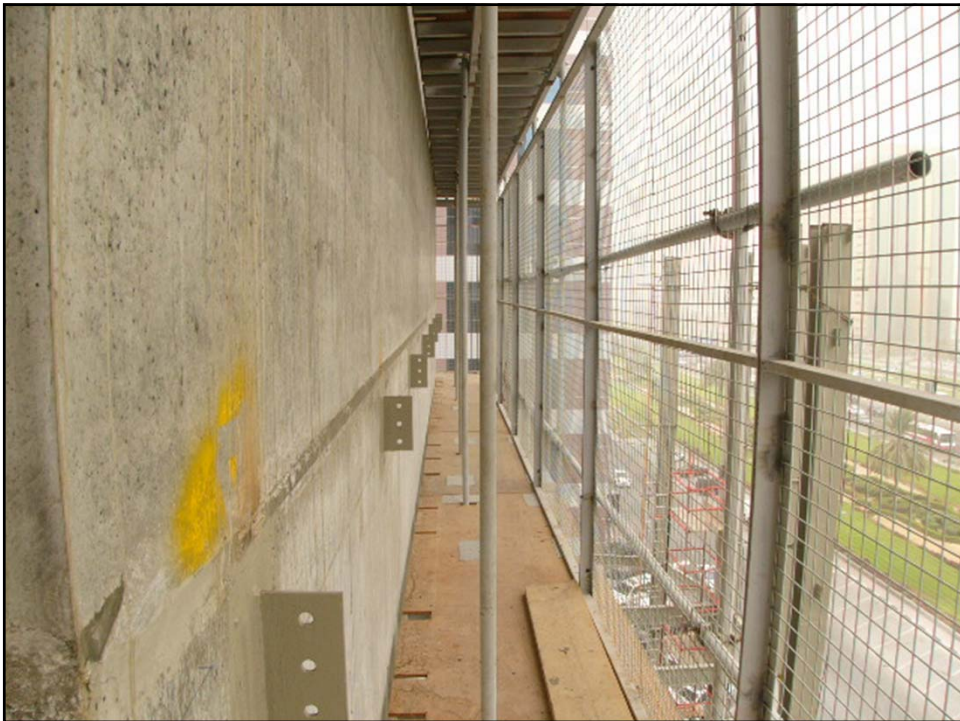
- Finally decided on self climbing jump form system by Grocon (Australia)
- Cross section through formwork system (check)

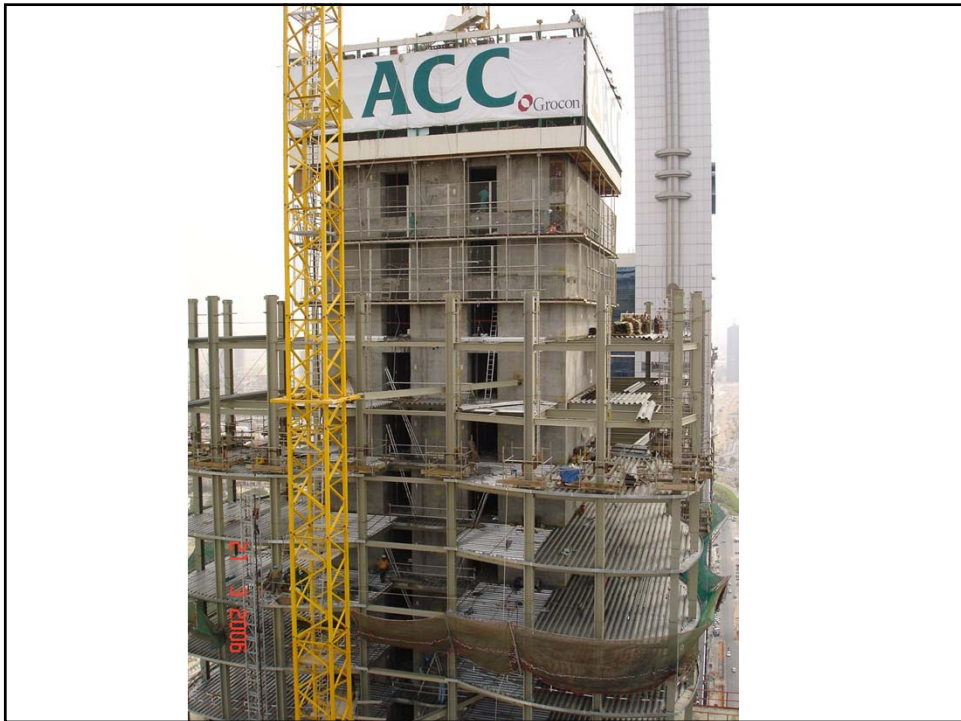














Formwork animation

