



Commissioning Repetitive Floors in a High-Rise Office Building

Corporate Center
Bank of America

- 2006 Engaged for Cx
- 23 Floor Renovation
- BAC Corporate Center
- Challenges - Execution
- Opportunities for Efficiency
- Team Member Actions
- Team Member Decisions
- Success



The Building

- HQ Bank of America
- 60 Story Landmark
- Cesar Pelli, 1992
- Still Tallest in Region
- 23,000 sf per Floor
- Infrastructure Upgrade
 - Finishes & Systems
- First Class Facilities
- Higher Standards
- Gold LEED-CI 2.0



- 23 Floors Total
- Multiple Phases
- 6 Floors Awarded
- Three Cx Plans
 - Pilot Gold - 19 & 21
 - Pilot Certified - 6
 - Phase 1 Gold - 14, 20, 23



Commissioning Scope

- HVAC Upgrade
 - Ductwork
 - Air Terminals
 - Fan Coil Units
 - Associated Controls
- Electrical
 - Day-lighting - Dimming
 - Automated Shades
- Plumbing
 - IWH



- Existing Air Handling Units
 - Except for New Filters
- Separate IAQ Project
 - Building Fresh Air
 - Building Exhaust Air



- Cx Joined Late in Design Development Phase
- Limited Schedule Input
- Compressed Cx Schedule
- Multi-floor Complexity
- Re-use of AHUs
- Subcontractors & LEED
- O&M Manuals, Training
- Tenant Issues



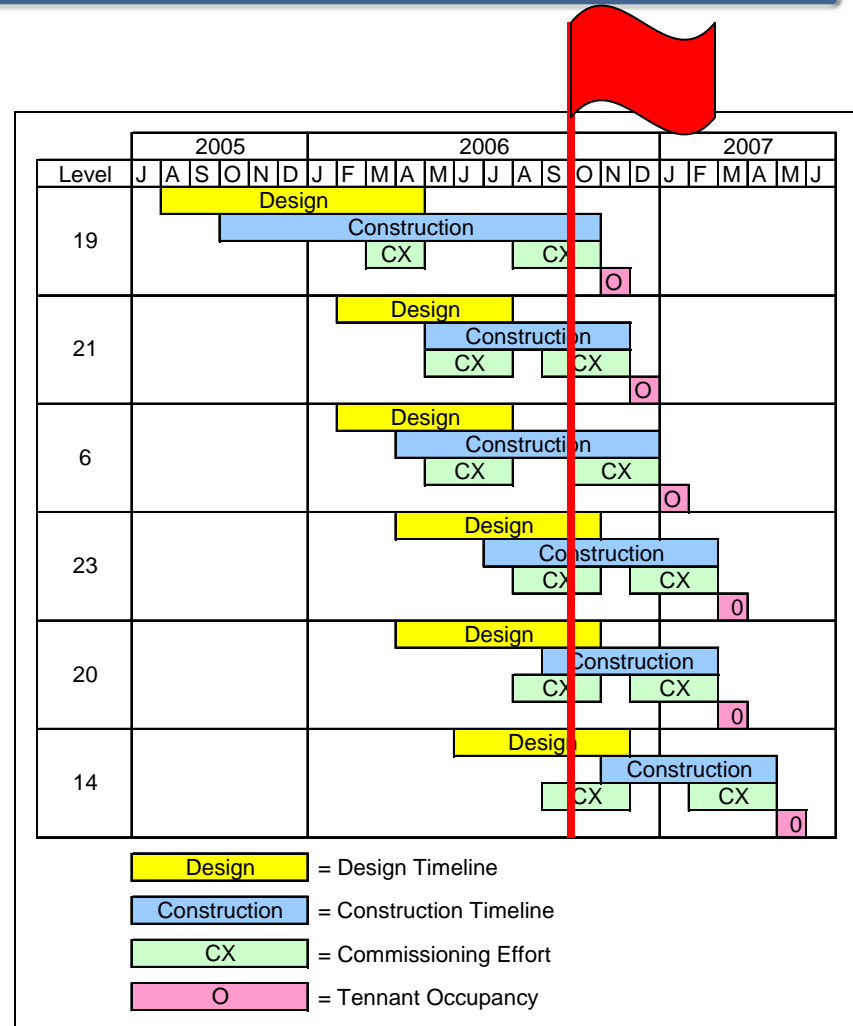
Cx Joined Team Late

- End of DD for Level 19
- Quick Design Reviews
- Owner's Requirements
- Basis of Design
- Verbal Communication
- Better Understanding
- Same Requirements for Following Floors



Overlapping Schedule - Challenges

- Overlapping Activity
- Similar Floors
- Potential Complexity
- Documentation Mistakes
 - Wrong form
 - Missing information
 - Wrong floor
- Required
 - Careful Recordkeeping
 - Reducing Complexity



Compressed Cx Schedule

- Fixed Occupancy Date
- Discovery Learning Delays
 - Design Team
 - Construction Team
 - Cx Process - Time
- System Sequences
 - Interdependencies
 - Ceiling Access
 - Power Late
- Resulted in
 - Increased Effort
 - Rework Cost from Some Trades, Ceiling Access



Re-use of Existing AHUs

- Less than Design Air Flow at Maximum Airflow Settings of All Terminal Units (VAVs)
- Potential for Peak Cooling Load Problems



Design vs. Actual Air Flow

<u>Floor</u>	<u>Design Airflow</u> (sum of air terminal units)	<u>Actual</u> <u>Measured</u> <u>Airflow</u>	<u>Deficiency</u>	
19	20,095 CFM	15,296 CFM	4,799 CFM	24%
21	22,440 CFM	15,784 CFM	6,656 CFM	30%

Existing Air Handlers – Alternatives

Investigation

- Check Original TAB
- Check Flow on Unmodified Floor
- Determine Existing Fan Capacity

Alternatives

- Upgrade to Unit Motor Controls to VFD
 - (now inlet vanes)
- Upgrade Motor Capacity
- Remove Inlet Vanes



Lack of LEED Experience

- Business as Usual
- Vendor Checklists
- Dependence on Cx
- Inconsistent Initial Results
- Follow-up, Coaching, Good Relationships

Typical Issues

- Similar Problems
- Data Not Project Specific
- Contact Info Missing
- Content Missing
- Electronic Files Not Clearly Named
- CAD vs PDF
- As-built Missing
- Narrative Incomplete

- Similar Issues –
 - Lack of LEED Experience
- HVAC & Electrical
 - General Briefing
 - They Will Call Us
- IWH & Shade
 - Simple
 - We Showed Them



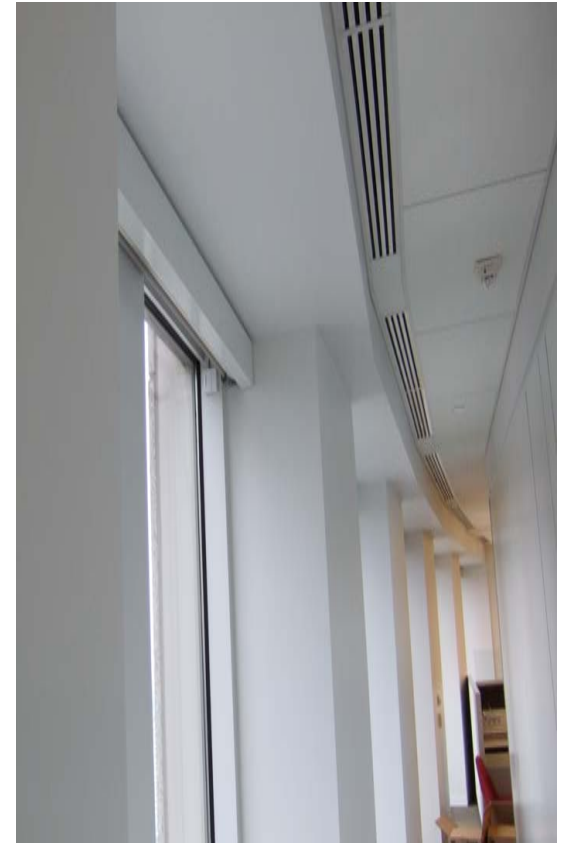
Frequency Operation

- Not Integrated
- Single Sensor per Wall
- Manual Override
- Interrupts Automation



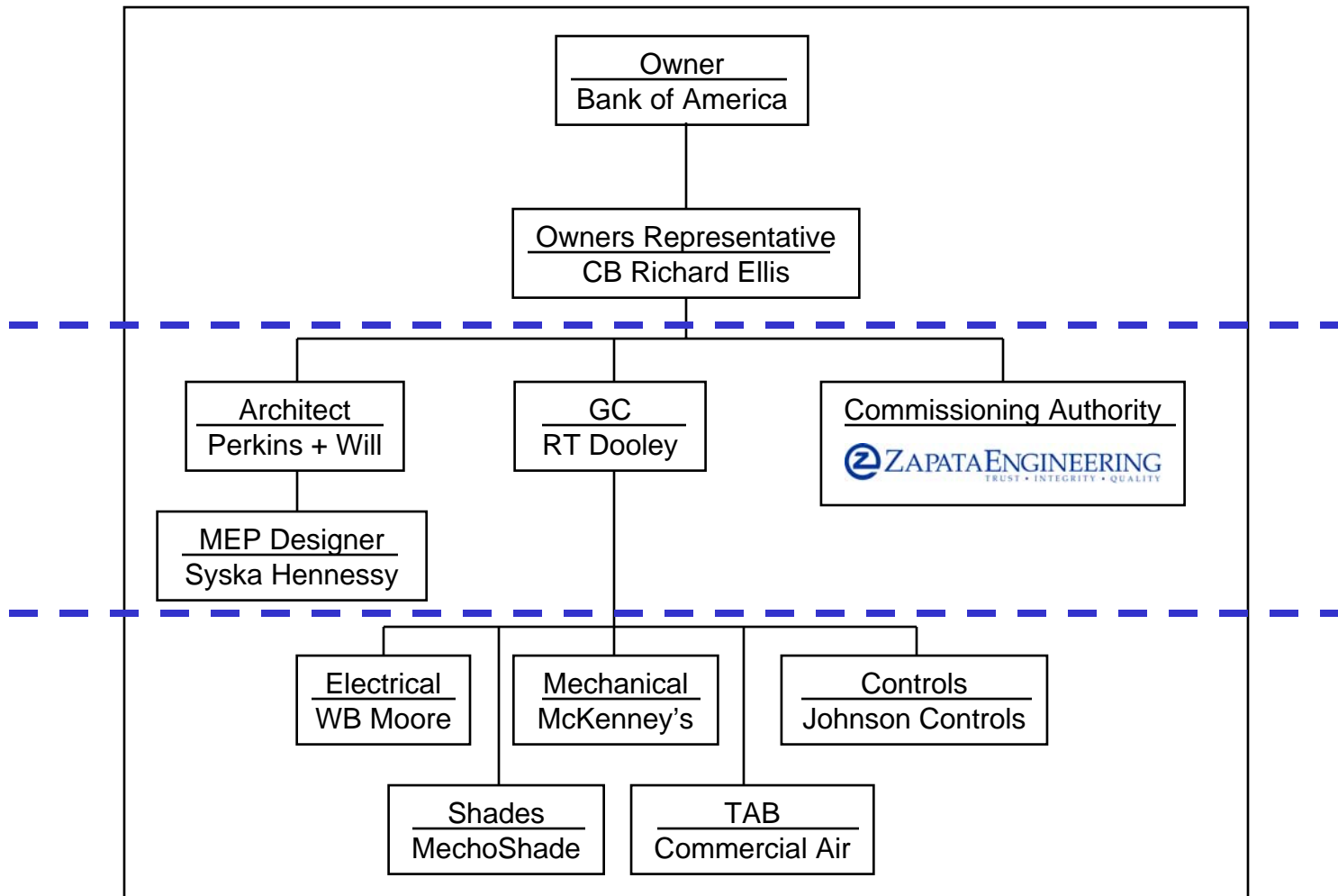
“Solution”

- Reset and Increase Delay for Automatic Adjustment
- Dimming Sensitivity Reduced
- Occupant Briefings

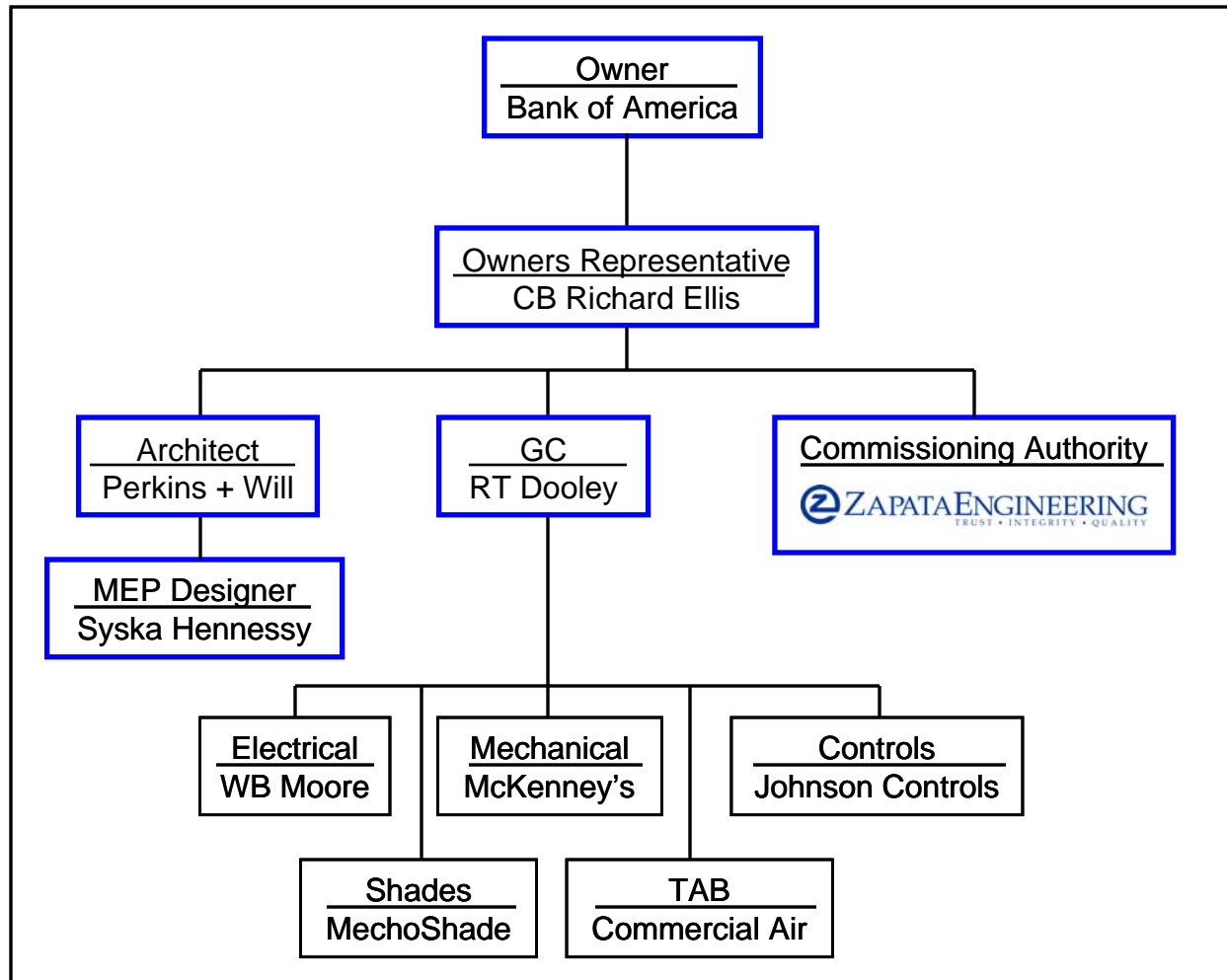


- Team Selection – Communication
 - Prior Experience Together
 - Prime Contractor’s Cx Experience - Engaged
 - Strong Subcontractors
- Chassis Design – Deliberate Efficiency
 - Grouping of Floors – Sequence of Work
 - Common Cx Plans – Reduced Paper Work
 - Lessons Learned – Immediate Benefits
 - Above Ceiling Pre-commissioning Walk

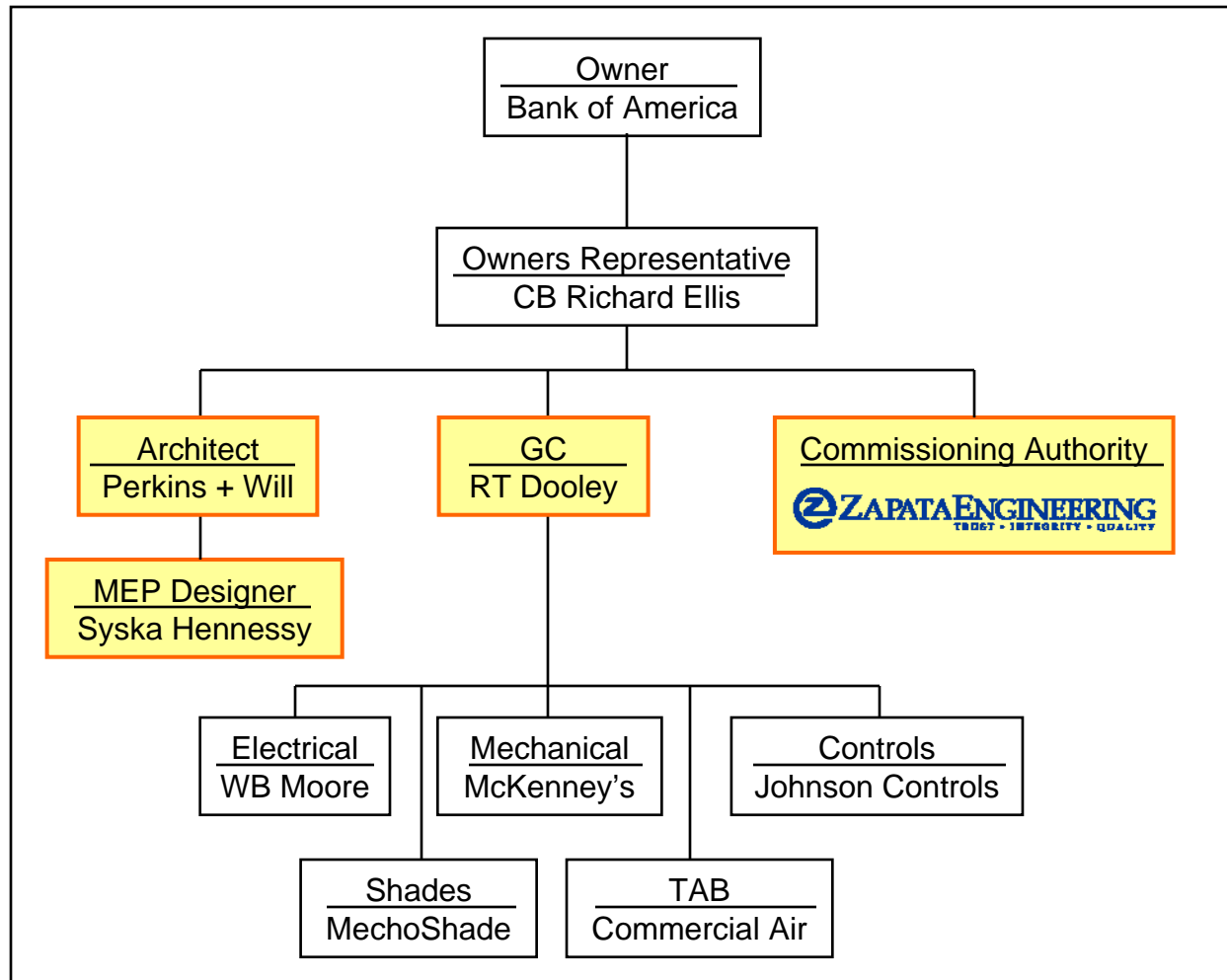
Team Selection



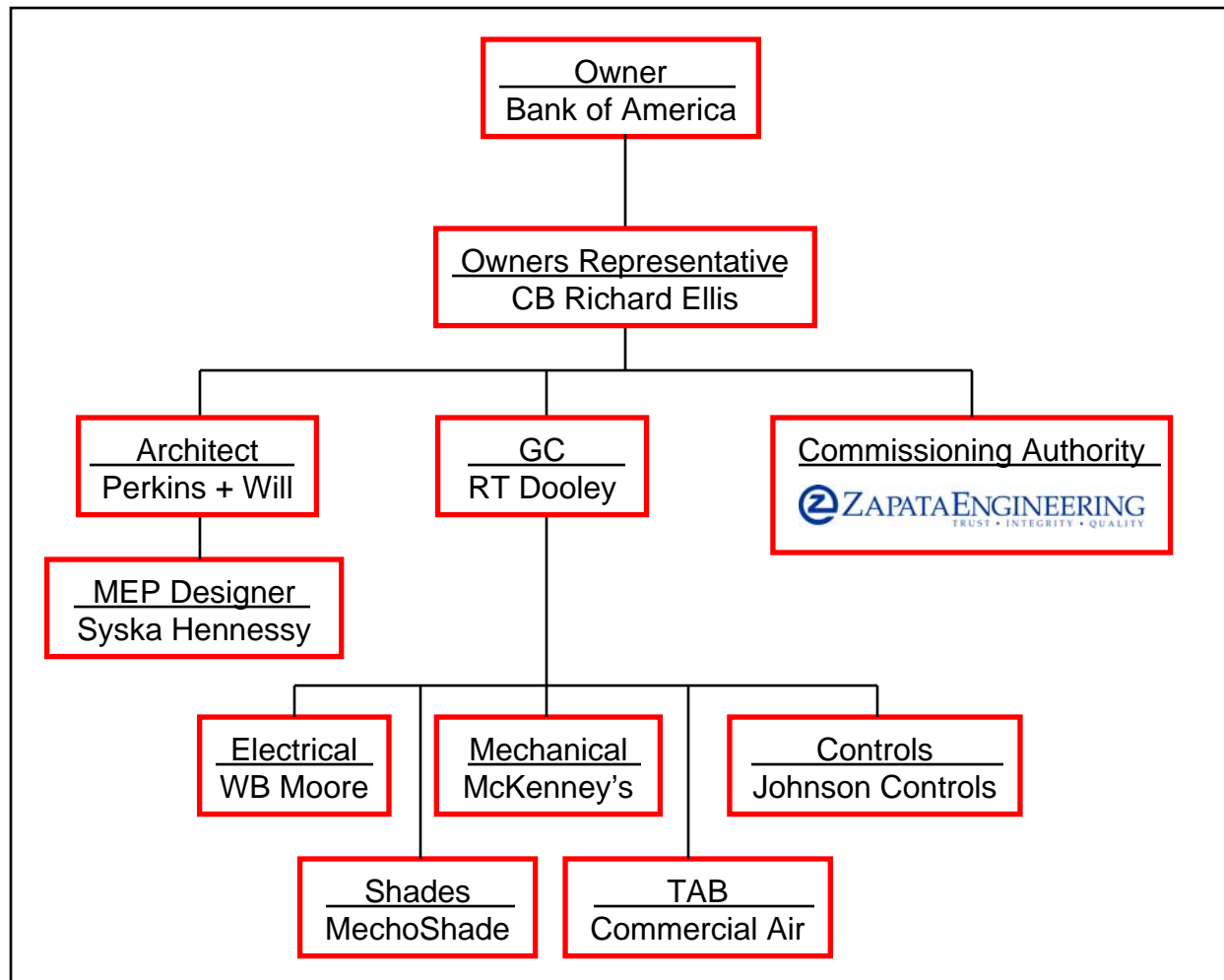
Owner & Cx Relationships



Commissioning Experience



Contractor Relationships



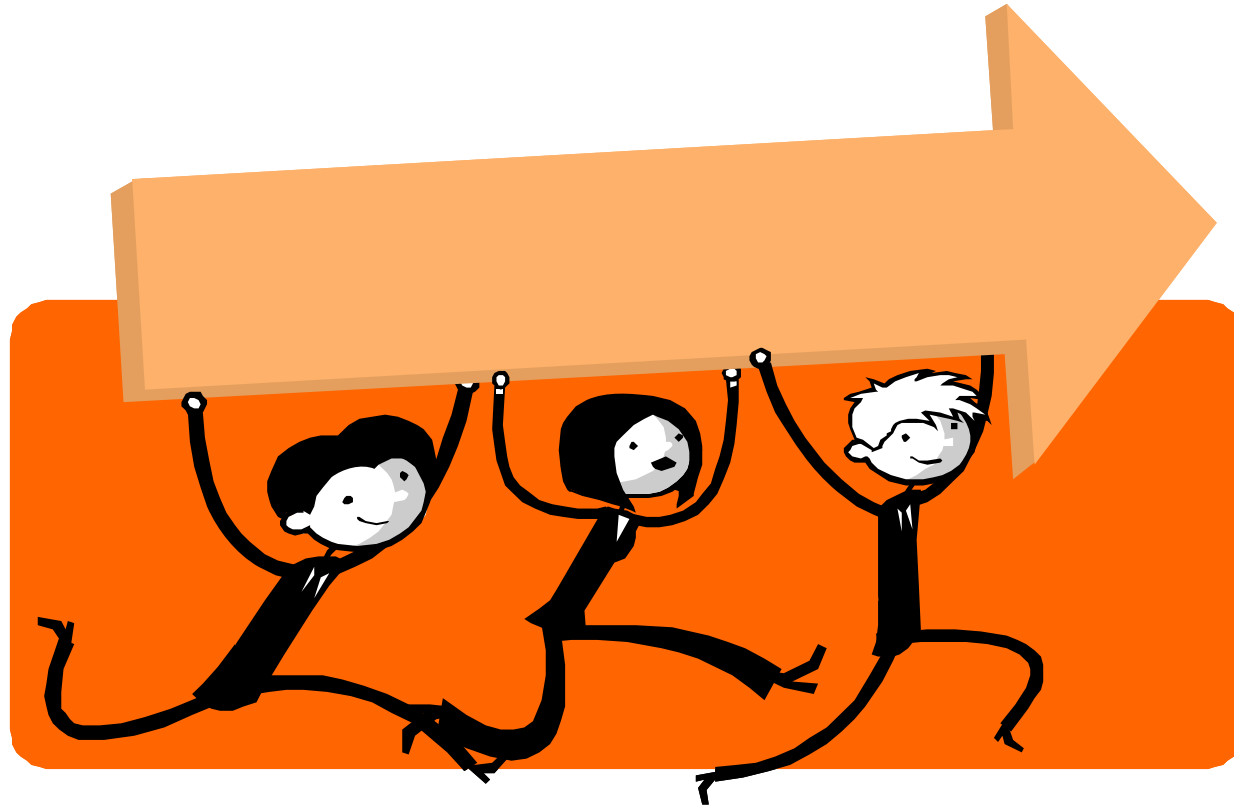
Trust



Communication

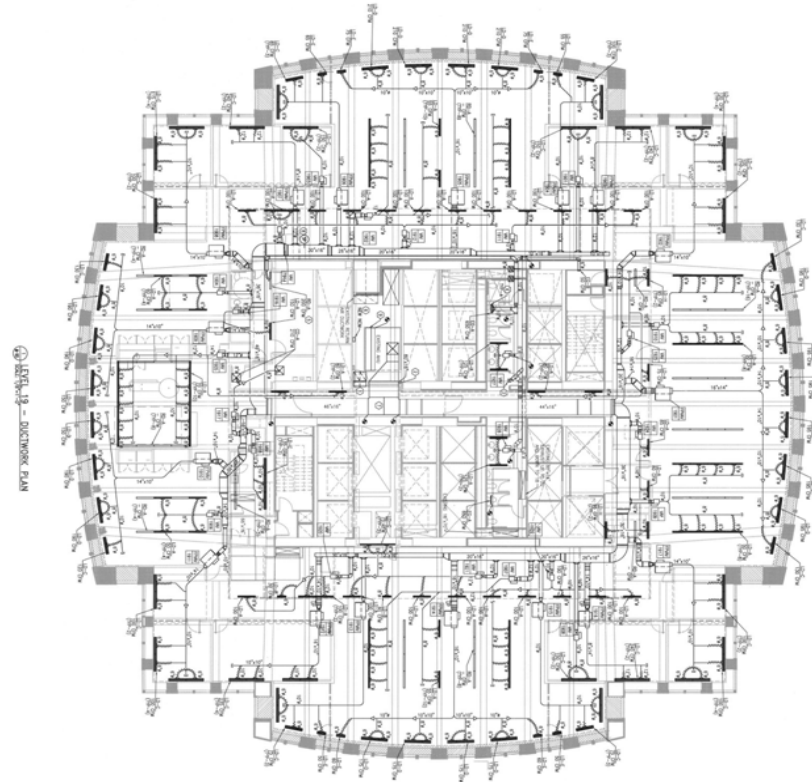


Teamwork



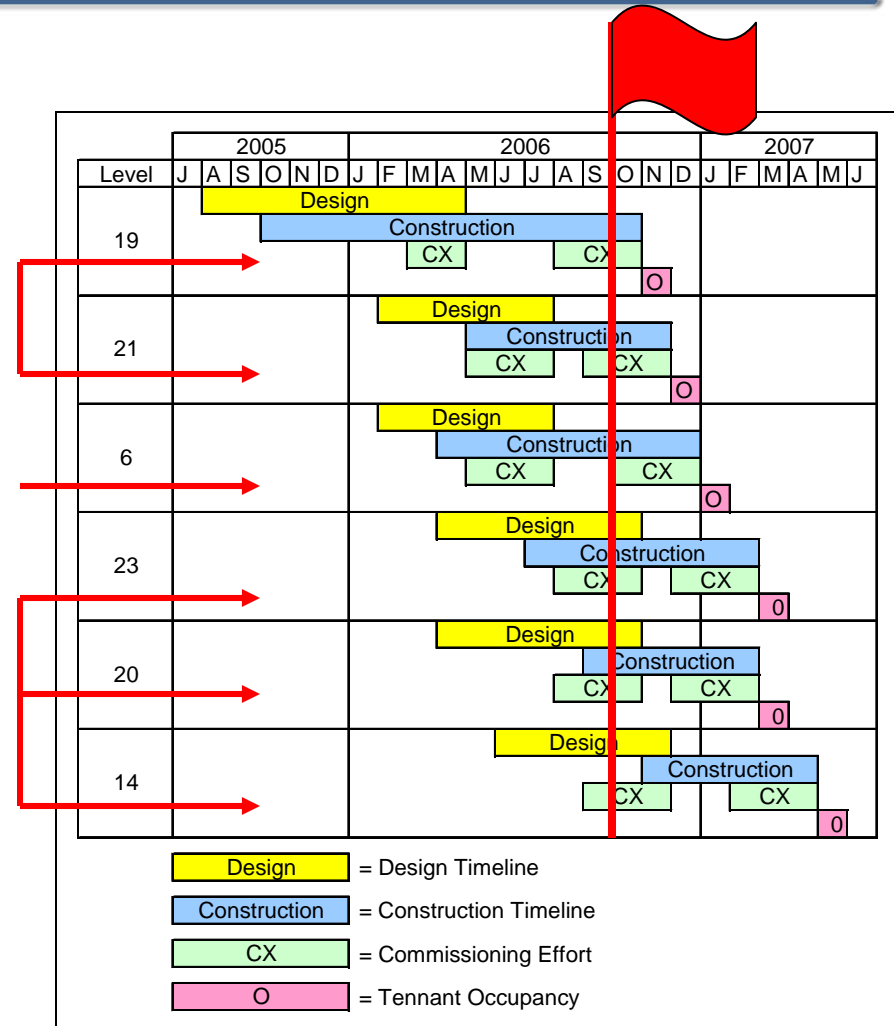
Chassis Design

- Common Design Foundation
 - HVAC
 - Plumbing
 - Electrical



Chassis Design - Benefits

- Chassis design made it easy and logical to group floors.
- Grouping Facilitated
 - Common Cx Plans
 - Design Reviews
 - Sequence of Work
 - Lessons Learned
- Result
 - Learning Curve
 - Shorter Performance Time



Common Cx Plans - Benefits

- Three Plans – Not Six
- Common Forms – Not Unique to Floor
- Minimized Number of Tracking and Reporting Documents
- Simplified Complexity of Documentation for All
- Easier for Subs to Follow the Plans



Pre-Functional Checklist

Level _____

Project: Bank of America Corporate Center

Lutron Ecosystem Private Office Lighting

Components included: (CS-1L-WM) Bus Power Supply, (C5-BMF-2A) Ballast Module, (ECO-1 Ballast, (C-R-M1-WH) Photo Sensor/ Infrared Receiver, (PN-IT-HF) Infrared Transmitter, (LC WH) Dual Technology Sensor

Associated checklists:

- 7 - Private Offices

mittal / Approvals

al: The above equipment and systems integral to them are complete and ready for functional testing complete and have been checked off only by parties having direct knowledge of the event, as marked to each responsible contractor. This pre-functional checklist is submitted for approval, subject to adding items yet to be completed. A Statement of Correction will be submitted upon completion of

Multiple VAV on one Form

4. Installation Checks

TU Tag #		TU Tag #		TU Tag #		TU Tag #		TU Tag #							
VAV-		VAV-		VAV-		VAV-		VAV-			Checkout Procedures				
Complete		Complete		Complete		Complete		Complete		Contr.					
Y	N	Y	N	Y	N	Y	N	Y	N						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Application and installation per mfr's recommendations and job specs. Specified sound wrapping and joint sealant installed.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Any high pressure ducting upstream has been leak and pressure tested, cleaned and approved prior to setting TU.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Model and tag checked against plans and equipment list. Tag or mark affixed.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Unit protected from duct and debris during construction. No visible damage to unit, unit looks clean.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Bottom access door provided where specified.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Unit secured per manufacturer's recommendations (threaded rod, etc.). Vibration isolation provided where specified.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Seismic bracing installed where required or specified.				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Unit has sufficient clearance to be serviced, and to meet NEC requirements (36" clear in front of electrical connections). -Access to bottom of unit -Access to change filter				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MC	Runout ductwork to unit is correct size per Contract Documents; proper reducing fitting provided where runout larger than inlet.				

Rapid Lessons Learned Results

- Lessons learned on Level 19 could be applied to Level 21 in a few weeks, and then subsequent floors.
- Reinforced Learning
- Above Ceiling Access
 - Pre-functional
 - Functional Testing



Above Ceiling Access

The Problem

- Compressed Schedule
- Ceiling Closed Early
 - Sprinkler Piping
 - Access for Maintenance
 - Flexible Duct
- Ceiling 4'x4' Tiles
- Fragile



Above Ceiling Access

Result

- Access Time Consuming and Costly
 - Broken Tiles
 - Required Ceiling Subcontractor



Above-Ceiling Walk Throughs

Team Solution

- Cx Progress Meeting
- Completion of Above Ceiling Work before Installation Critical
- Team Walk-through
 - Cooperation from All
- Contributed to and a Result of Learning Curve
 - Faster Construction Made Time for Better Coordination



Conclusion – Early Decisions Drive Success

- Team Selection – Communication
 - Prior Experience Together
 - Prime Contractor's Cx Experience - Engaged
 - Subcontractor's Cooperation - Relationships
- Chassis Design – Deliberate Efficiency
 - Grouping of Floors – Sequence of Work
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