

Construction Management of Songdo IBD, Korea

POSCO Engineering & Construction
Architecture Division
Architecture Technology & Design Group
CM Part
28th April 2010

posco e&c

GLOBAL
POSCO WAY

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1. Project Synopsis

1.1 Project Summary: Songdo IBD Development (Int'l Business District)

Project Summary			
	Description		
Developer	NSIC (Share Holdings : Gale International 70.1%, POSCO E&C 29.9%), Established : 2002. 3. 18		
Location	Sections 1, 3 of Songdo Int'l City (including part of Sections 2, 4)		
Developing Area	5,740,000 m ² (1.73 million PY)		
Period	2003 ~ 2014		
Planned Population	Resident : 61,500 people / 22,660 Residential Units Full-time Employee : 264,000 people		

Master Plan			
Section	Site Area	Total Floor Area	Remark
Business	760,000m ²	4,360,000m ²	40 blocks
Commercial	160,000m ²	430,000m ²	20 blocks
Residential	Apartments	770,000m ²	26 blocks/ 14,960 units
	Mixed-use	410,000m ²	15 blocks/ 7,500 units
	Villa	150,000m ²	1 block / 151 unit
Cultural/Educational/Medical	460,000m ²	1,070,000m ²	
Sports/Parks/Others	2,130,000m ²	600,000m ²	
Total	5,740,000m ²	10,200,000m ²	

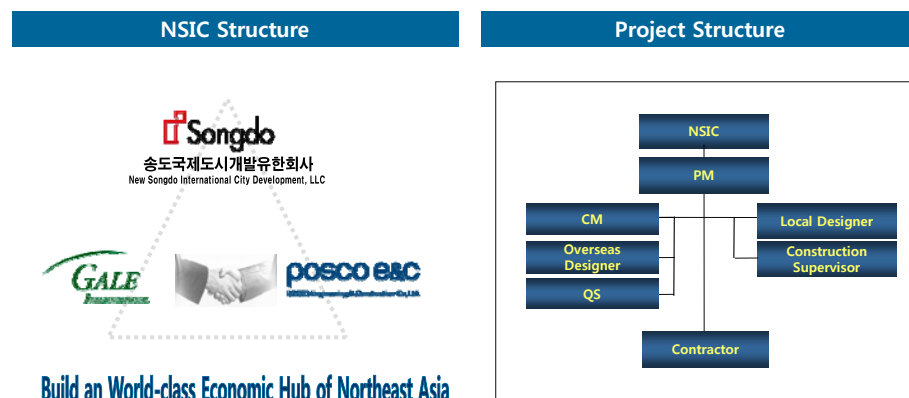


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1. Project Synopsis

1.2 Songdo IBD Development Project Business Structure



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1. Project Synopsis

1.3 Project Summary and Characteristics

Project Summary

Classification	Description
Project Name	Construction Management of Mixed-use Residential Block 125 of New Songdo International City
Owner	New Songdo International City Development LLC (NSIC*)
Participants	Architect: KPF /Main Contractor: POSCO E&C /CM: POSCO E&C /Others: TCMC(CS*), DLSK(QS*), Cosentini (LEED*)
Location	# 4-1 Songdo-dong, Yeonsu-gu, Incheon City
Work Classification	High rise apartments / residential and office buildings / officetel
Project Scale	2F belowground / Apartments 64F 4 buildings, 26F 2 buildings / Officetel 23F 2 buildings, 7F 4 buildings / retail 2 buildings / Total floor area about 530,000m ²
Project Period	2005.3.30~2009.1.31
CM Service Period	2005.4.1~2009.1.31
Total Construction Cost	807,044 (million KRW)
CM Service Cost	22,980 (million KRW)
CM Terms of Payment	Fixed rate of the construction cost
CM Procurement Method	Other
Participation Stage	Design stage, Construction stage, Post-construction stage

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Project Characteristics

- **Forefront Pioneer Project in Songdo IBD**
- The Highest (225m) and largest pure RC structure building in Korea
- Cutting edge technologies such as TLCD, RC Outrigger, GFRC*, water-cooled air conditioning and etc. which were rare in Korea.
- Targeting LEED certified of US Green Building Council (LEED NC 2.2)



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2. NSIC Project Management System

2.1. Proposed International Standard based Contract ▶ Applied through Songdo projects

CM Contract

Contract background

- POSCO E&C was in charge of both CM and main contractor.
- Draw a reasonable construction cost to satisfy both owner and contractor
- Based on the international standard contract
- Fast Track construction type

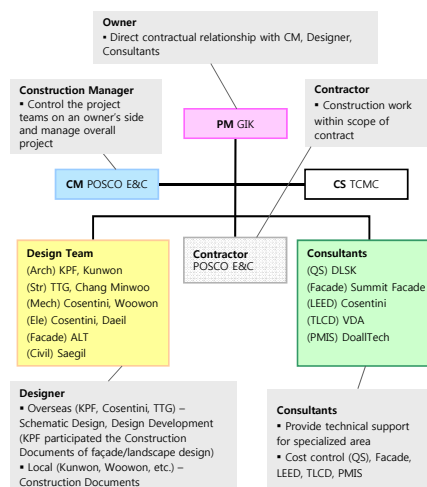
Review the standard contract of USA

- AIA A212 CMc : CM as Constructor
CPF+Guaranteed Maximum Price
- AIA B801 CMa : CM as Advisor ▶ Assented and applied
- AIA A101 & A201 : Traditional Lumpsum Contract
Amended CPF+Lumpsum Contract

US AIA standard forms of contract

- Reviewed and proposed the AIA standard contract for CM and construction
- Construction contract : based on standard of AIA A101 & A201
- CM contract : based on standard of AIA Document B801CMa

Proposed Organization: the Int'l Project Type

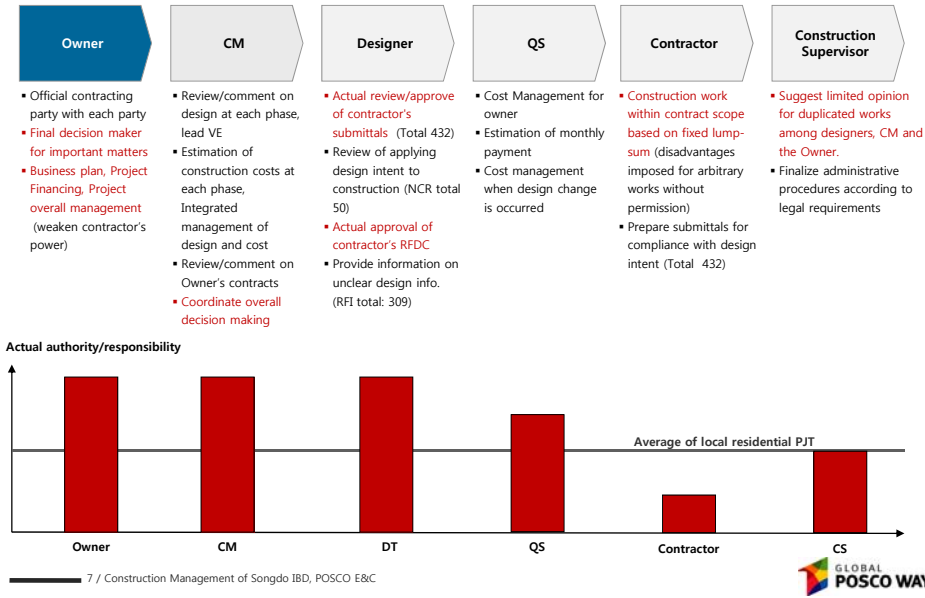


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2. NSIC Project Management System

2.2. Roles & Responsibilities Matrix (based on differences from local residential PJT) ► Applied thru Songdo projects



2. NSIC Project Management System

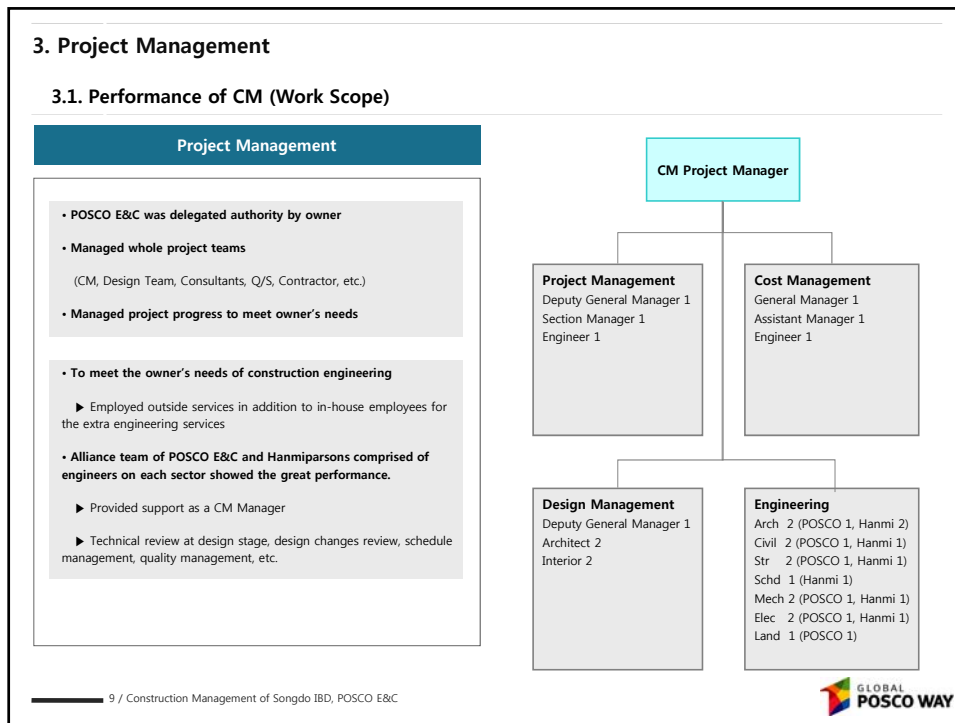
2.3. CM Work Scope Proposal (Based on the contract) ► Applied thru Songdo projects

Pre-construction stage		Construction stage	
Project Management	- Review the owner's programme and requirements (schedule, budget, etc.) - Support owner's legal/statutory/planning requirements or constraints - Develop a communication tool	Project Management	- Establish and control construction progress procedures - Construction administration and management - Operation and maintenance of PMIS - Administrative management for contractor's roles and responsibilities - Design changes review, consultation of contractor's proposals, advice
Design Management	- Review the design at each stage and suggest the optimum idea (building system, method of construction, materials selection, etc.) - Value engineering - Manage design process	Design Management	- Review the design and suggest the optimum alternative - Value engineering - Design processes management
Cost Management	- Draw up project cost plan and future cash flow - Estimate predicted construction costs at each design stage - Analyze the cost of design alternatives	Cost Management	- Monitor the approved estimate of cost - Suggest on an excess over the estimates - Review monthly payments and the final payment
Time Management	- Make project schedule and update periodically - Suggest the optimum project schedule analysis	Time Management	- Establish and update the project master schedule - Analyse the project progress and establish a catch-up plan
		Quality Management	- Mediate and manage approval of contractor's submittals - Inspect with design teams and direct necessary corrective actions

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3. Project Management

3.1. Performance of CM (Work Scope)



3. Project Management

3.2. Establishing Critical Project Control Point

Critical Control Point	Project Characteristic	Management Solution	Anticipated Effect
Applying international CM process/level due to overseas client	- Client NSIC : Foreign Company - Director, CEOs : Foreigners - Project Manager : People who did projects in overseas	Applying international level of PM, construction contract and CM technique of int'l project	
Localising world-class int'l design	- Design Development: International overseas designers - Construction Document: Local designers	- Maintain initial design intent - Processing construction design to fit local condition	
Managing project participants' decision making	- Designer observed responsibility/duty of main design issues (Applied international standard) - Designer's Construction Administration : continuously checking a construction fidelity	Managing decision making to fulfill owner's and designer's intent	
Finding and applying new technique/new method of construction	- Applied cutting edge technologies such as TLCD, RC Outrigger, GFRG, water-cooled ducted system and etc. - Drove forward to acquire LEED for whole projects of IBD	Reducing obstacles applying new techniques/new method of construction	
Completion within budget and time	Managing design costs, construction costs, etc. within owner's planned budget	- Design & Cost integrated management at design stage (construction cost forecast/analysis, etc.) - Minimizing an additional cost such as design changes at construction stage	- Contribute to whole development by successful completion of forefront pioneer project - The great model case for following projects

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3. Project Management

3.3. Application of Project Management System

Periodical Meeting and Reporting

- Periodic Meeting
 - Bi-weekly Meeting : Discussion for project main issues
 - Design Coordination Meeting & LEED Meeting : Discussion for each specialty section
- Periodic Reports
 - Biweekly Progress Report
 - Current Status of Issues Report
 - PM Report
 - CM Monthly Report

Minutes of Meeting 

New Songdo City Development
B125 Project

Subject: Periodic Project Progress/Coordination Meeting
Number: B125-MPM-PCH-0043 Location: 62F - Songdo Conference Room
Date: 2009-01-22 Year Started: 10:00 Year Ended: 12:00

No.	Item Discussed	Status	Original Due Date	Current Due Date
0043-0001	Approval of use	Open		

Commentary Date	Description	Type	Resp.	Start Date	Close
2009-01-22	- Final approval of use was not complete due to contractor's complaints. - There was possibility that approval could be postponed to next week depending on circumstances. - Regarding the items of deficient construction raised by contractor, CM would check on the site after the meeting. - Final tender and base final handover completed on Jan. 24, and detailed finishing up will go on until the end of January.	Information			☐

Construction Closeout

- Provided a guideline for contractor to close a project as by an owner wanted
- Criteria for construction completion and final estimation
 - Contract Closeout Checklist
 - Project Closeout Checklist
 - Project General Report
 - Project Financial Report
 - Inspection
 - O&M Manual

APPENDIX A
Contract Closeout Checklist

Project Name	Project #
General Contractor	CM Firm
Project Start Date	Project Finish Date
Closeout Checklist Completed	

ITEM	Due Date	Date Completed	Distribution				Remarks	Signature
			PM (HQ)	CM (Phase E&C)	COST CONSULTANT (CLM)	CM (Construction Mgt)		
Prescriptive Items								
Record Drawings (incl. CD-Rom)								
Operation & Maintenance manuals (incl. summary)								
Spare Parts and Maintenance Products								

3. Project Management

3.3. Application of Project Management System

Design Review at Each Stage

- With participation of local and int'l architects and consultants including KPF (US) in charge of basic design and architectural design, foreign consultants such as Cosentini (US), Weidinger (US), Towers Golde (US), TTE (US), ALT (Philippines), and VDA (US) and Kunwon in charge of CD and approval and permit, and other local designers such as Woowon, Daeil, Ungdo, Saekil and Kyowoo, it took a long time to develop the design.
- Design review was a top priority to optimize degree of completeness by design stages owing to the characteristics of the project that the basic design was made by overseas architect and the domestic architects localized it.

Request For Design Change 

New Songdo City Development
B125 Project

To: [JHKG] Donghyuk Kim Date: 06-01-2009
CC: [SKK] Youngsoo Kim Ref. No.: A3-BPDC-PHC-0008
From: [JHKG] Nemo Song

Rev. Date: 06-01-2009
Classification: Architectural
Subject: Louver at 3D Open Shop on FL2

Approval Required Date: 20

Dear Mr. DWH Kim,

In relation to the captioned issue, we request for design change as shown below.

Item	Description
Item	Louver and adjacent interior wall
Location	Open Shop on 3D FL2

[Request For Design Change Document]

Design Change Management

- Design Change- defined as amendment or change of technical requirements specified in the approved design document or the changed document
- Feasibility and applicability of the amended or changed documents and the impacts on the construction period and cost were comprehensively reviewed and managed.
- In particular, LEED was being pursued when construction was in full swing.
 - ▶ A factor that made project design change management more difficult
 - ▶ Coordinated and managed owner's LEED consultants and designers, QS and contractor positively
 - ▶ Applied LEED in a limited time

Design change management process

- Design changes occurred during construction
 - ▶ Contractor or designer propose the request for design change through PMIS.
- When a design change is requested,
 - ▶ CM nominates the relevant consultant who was to make a feasibility study on the proposed contents
 - ▶ CM puts together various contents of review to give technical support for PM's reasonable decision-making.
- Changes in construction cost and/or construction period
 - ▶ Reflected to the contract through Change Order (C/O)

4. Project Cost Management

4.1. Summary

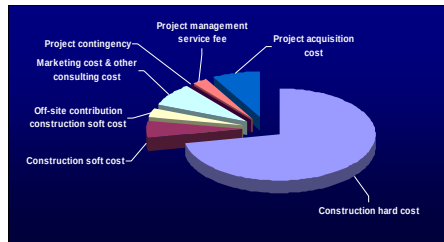
Design & Cost Integrated Management to complete the project within the owner's budget and time

Project Cost Details and Management Plan

- Most of project cost consists of construction hard & soft cost.
- Construction hard cost consists of contract construction cost and preliminary
- Construction soft cost consists of consultant's service fee such as CM, QS, CS, Design and others.
- Critical Control Point: Construction hard cost & soft cost
- Management Plan:

Pre-construction stage [D & C Integrated Management]

Construction stage [Contract Integrated Management]

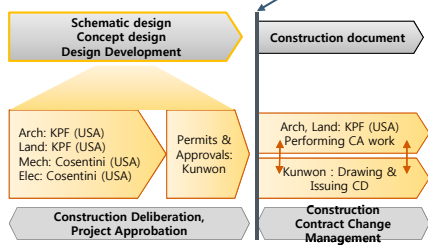


[Project Cost Composition of the # 1st World]

Understanding Design Stages

- Basic design by overseas designers
- Project Approval Document & Construction Document by domestic designers
- CM : coordinating dissents between an owner, overseas designers, domestic designers and QS
- Converting the original design by overseas designers to meet local code and regulation

- Fast Track design progress -> Drawing CD and construction at the same time



[Design Process]

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4. Project Cost Management

4.2. Construction Hard Cost

4.2.1 Design & Cost Integrated Management at Pre-Construction Stage

Design Stage	Design Review		Estimation Level	Result
	Yes/No	Detailed review		
Schematic design	Yes	Focusing on marketability in Korea housing market	-	Finalising OPR (Owner's Project Requirement)
Concept design	Yes	Reflecting contents of deliberation and finalising basic drawing	Basic	Finalising BOD (Basis of Design)
Design development 50%	Yes	Checking reflection of negotiated changes	Basic	Continuing documents developing
Design development 75%	Yes	Coordinating a interference btw different parts	-	Increasing perfection of documents
Design development 100%	Yes	Adjusting the perfection as a contract document	Basic	Finalising contract document
Document for Project Approbation	Yes	Coincidence with DD and local code as a contract document	Basic	Finalising contract document
Construction document 90%	Yes	Coincidence with CD and owner's requirements	Partially detailed	Setting up target budget for undefined items
Construction document 100%	Yes	Issues that wasn't detailed due to the budget limit	-	Finalizing construction document and EAC

* Remaining design management items after binding a contract

	Adopting Additional Design Items	Changes of Original Design	Settle-up After Finalizing Design
Outstanding Design Issues	- TMD system - Ubiquitous healthcare system - Gymnasium	- Steel frame outrigger & belt truss - Elevator spec down	- Mat concrete thickness - Additional sheathing & excavation - Link beam - Concrete & Re-bar

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4. Project Cost Management

4.2. Construction Hard Cost

4.2.2 Understanding Construction Contract

Summary	- Type : Firmly Fixed Lump Sum - Basis Documents : DD100%, Project Approval Document, Assumption
	Contract General - Based on a domestic standard contract, however, derived a part of design, contract, construction progress and payment management from AIA
Characteristic of General Conditions	Contract, Design Change - As a fixed I/S based on a contract document, later changes are approved as a design change. - As a contract as of DD 100% stage was not detailed as much as a construction document so that disputes of design change were arisen along by progress of detailing design. - Interpretation and application of "Reasonably inferable" clause of general conditions was a key point.
	Project Progress - As like as a characteristic of AIA A101 (standard form of contract) and A201 (General conditions), role and responsibility of owner, designer and contractor were prescribed precisely, and also rough outline of work procedure was noted on the contract. - According to this, after establishment of work procedure matrix, all works were enforced by the procedure. (similar to overseas projects)
Characteristic of Contract Amount	Unsettled contract amount (app. 63 bil. KRW) - Contingency items : app. 31 bil. KRW - Outrigger, TMD, Elevator, U-health care, Gym. - Cost added at finalizing design - Provisional items : app. 26 bil. KRW - Adjustment of Mat Con'c thickness, Additional Sheathing, Link beam. - Settle-up contract amount after finalizing design - Discount items : app. 6 bil. KRW - VE for quantity of RC, CAR (Contractor's all risk insurance) - Settle-up or maintain according to offer condition
	Adjustment of contract amount is essential btw contract document and construction document - Contract is based on DD documents - Differences btw contractor's assumption at DD and CD were admitted partially for a settlement of account. - However, developing of design which is not considered as design change was not accepted.
Interpretation of Contract	Criterion of Contract Application - Application of ambiguous clauses is, according to intent of contract. - admitted in accordance with the business agreement 'Block 125 of Phase 1 of the New Songdo City Development Project in Incheon' and 'Starcity Project' which mentioned as a example project.

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4. Project Cost Management

4.2. Construction Hard Cost

4.2.3 Contract Integrated Management at Construction Stage

RFDC Management

Classification		Request for Change		Change Management			Result	
		Submit (No. of Items)	Proposed Cost (bil. KRW)	Duration (Day)	Comment (No. of Items)	Reject (No. of Items)	Approved (No. of Items)	Certified Amount (bil. KRW)
Arch	Structure	1	3.1	3	5	-	1	1.9
	Architecture	57	-0.2	2,692	459	26	31	-0.2
MEP	Mechanical	26	3.3	815	243	12	14	0
	Electrical	7	2.0	554	82	1	6	0
기타	LEED	9	1.1	556	115	4	5	0.6
	Etc	10	3.4	498	95	1	9	3.4
TOTAL		110	12.7	5,118	999	44	66 (60%)	5.7 (46%)

• RFDC : Request For Design Change (Design change request form)

• To prevent contractor's thoughtless RFDC, selected items needed for project were certified.

Management of unsettled amount

Classification		Category			Total (KRW)	Remarks
		Contingency	Discount	Provisional		
Noted Items of contract	Pre-reflected items on contract	-	-	26 bil	26 bil	VE example: RC Outrigger, TLCD, etc.
	Predicted additional cost	31 bil	6 bil	-	37 bil	
	Value Engineering	-13.5 bil	-3.8 bil	-2.6 bil	-19.9 bil	
	TOTAL	17.5 bil (56%)	2.2 bil (36%)	23.4 bil (90%)	43.1 bil (68%)	

Additional Design Management Service

• Cost/Design Management for provided documents by CCD (Construction Change Directives) and CD Addendum

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4. Project Cost Management

4.2. Construction Hard Cost

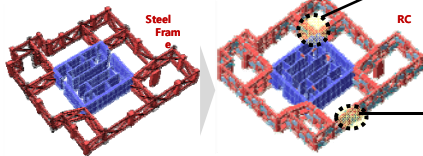
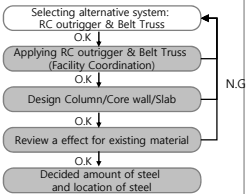
4.2.4 Value Engineering

Value Engineering

■ RC Outrigger & Belt truss

- Installing RC Outrigger and Belt Truss as a lateral reinforcing structure of high-rise building(34F/60F)
- Designed as a steel on CD
- Cost burden** as a contingency item which was predicted adjusting cost as of final design
- Time burden** as a complex process because the core structure was RC.

RC Outrigger Design Flow Chart



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Result

■ Effect of Application

Time Saving

- Concerned construction time increase as a complex process because the core structure was RC.

• **Saved 2 Months**

Cost Saving

- Concerned cost increase as a original steel structure

• **Saved 3.8 bil KRW** by VE

Outrigger(33F, 60F)

- Upper Horizontal Member : 1200mm X 1200mm
- Middle Horizontal Member : 1200mm X 800mm
- Bottom Horizontal Member : 1200mm X 500mm
- Vertical Member : 1200mm X 1000mm
- In filled Wall Thickness : 1200mm
- Compressive Strength : 80Mpa

Belt (33F, 60F)

- Horizontal Member : 500mm X 1000mm
- Vertical Member : 500mm X 1000mm
- In filled Wall Thickness : 500mm
- Compressive Strength : 80Mpa



4. Project Cost Management

4.2. Construction Hard Cost

4.2.4 Value Engineering

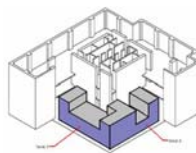
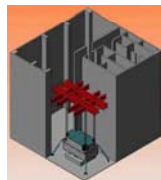
Value Engineering

■ TLCD (Tuned Liquid Column Damper)

- Considered TMD (Tuned Mass Damper) for a **dampener system** of a high-rise building
- Considered installing only 1 tower building of 4 tower buildings because of huge cost burden
- However, due to predicting civil complaint a plan for installation of all 4 buildings was seek.
- Reviewed several systems such as TSD, TLD, etc. and then TLCD was selected finally.

TMD

TLCD



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Result

■ Effect of Application

Efficiency of Damper

- Original TMD has high prime cost, uncertain performance and needed extra space at top of building
- Reviewed failure cases of similar local system before using TLCD of Motioneering Company, and then **corrected errors rising from difference btw real building and model to improve TLCD design.**
- Finished Tuning of TLCD perfectly. Achieved perfect design efficiency.**

Cost Saving

- Considered equity for installing only 1 building due to cost burden
- Through innovative VE, **saved cost (app. 6 mil KRW)** and even also it could applied for all 4 building within the budget.



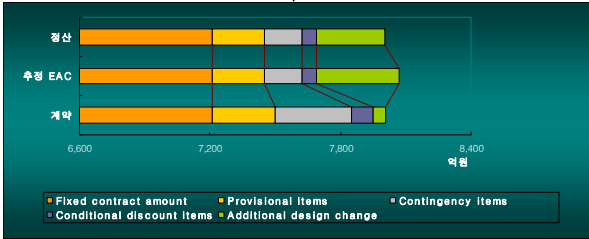
4. Project Cost Management

4.2. Construction Hard Cost

4.2.5 Management Outcome



- Securing maximum leeway of owner's budget by Design/Cost Integrated Management
- Managed design and contract at the same time for **detailed design and extra design** due to Fast Track design progress -> Optimization
- Unsettled cost were minimized by proactive Value Engineering
- Intensive management for additional Scopes such as LEED
- Met the target of **Construction Hard Cost** at the final settlement of account
- Achieved **99.93% of Contract Amount 99.1% of EAC (Estimate at Completion)**



4. Project Cost Management

4.3. Construction Soft Cost

4.3.1 Service Contract and Claim Management

Service Contract Management

■ Additional Contract and Existing Contract Management

- Bound the contract by USA standard notwithstanding a domestic project due to lack of communication btw Gale and Gale International Korea at the beginning of project.
- Different contract conditions of domestic/overseas service contract of each company
- Reviewed a grey area for operating a project

Overseas Contract	Omitted Contract	Domestic Contract
Arch Basic Design	Amenity Interior	Arch Construction
MEP Basic Design	Arch CA Works	Drawing
Strc Basic Design	Infra Change Design	Design Change for government
Facade Consultant	Retail Interior	Approval/Permit
LEED	MEP CA Works	Drawing
Main Lobby Interior	TLCD Design	Unit Interior
		DLK
		MEP Construction Drawing

- CM Management for overall service contract
- Reviewed the omitted part and managing additional contract binding
- Claim for service and settlement of account

Claim Management

■ Claim by Designer

- Occurred designer's loss by undergoing trial and error at beginning of project
- Claimed 4.9 bil KRW to NSIC on May 2006
- Requested CM to settle a claim

Performed Item	Predicted Item	Additional Item
CD documentation & modification Requested app. 2.9 mil KRW	Change for Project Approval Requested app. 2 mil KRW	
Excepting Designer's fault Agreed 0.7 bil KRW	Except existing contract items Agreed 0.7 bil KRW	Additional Design such as TLCD Agreed 0.2 bil KRW

- Management for owner's claim issue
- Negotiation by considering predicted possible disputes (→ 1.6 bil KRW)
- Inclusion of possible additional designs -> prevent future disputes

5. Time (Schedule) Management

5.1. Plan vs Actual, Revision Schedule Management (Primavera3)

Not limited to Construction Activity, managed whole schedule of Design, Permit, Procurement, Shop DWG and Submittals

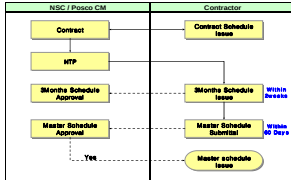
CPM (Critical Path Method) Management

- WBS
- EPC : Milestone, Design & Permit, Procurement, Construction
- Construction : High Rise 4, Middle Rise 10
- > WBS (Code of account identifier)

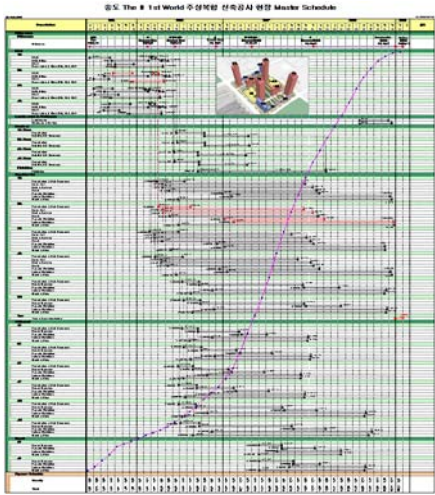


Approval of Master Schedule and Revision Process

- Clarified the standard clearly when establishing early schedule management plan



Master Schedule

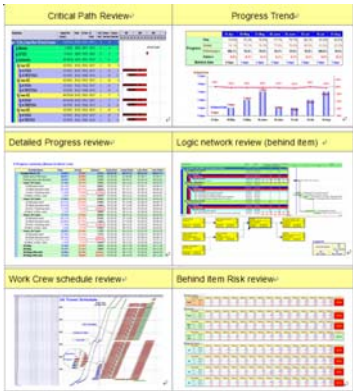


5. Time (Schedule) Management

5.1. Plan vs Actual, Revision Schedule Management (Primavera3)

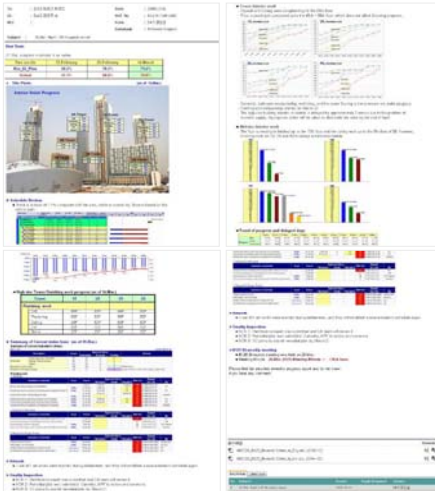
Plan and Actual Result Management

- Update progress status by bi-weekly
- Analyse actual result by plan and progress Trend
- Check critical issue and identify risks to report to an owner



[Biweekly Update Issues]

CM Biweekly Report



5. Time (Schedule) Management

5.2. Time/Cost Integrated Management by Earned Value Management

Major Resource Management

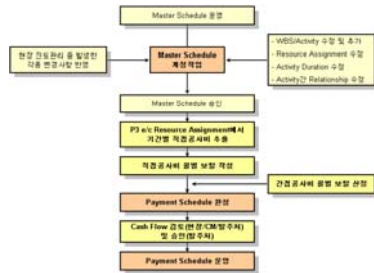
- Reclassification/gathering items of a breakdown of construction contract by a breakdown of each building/each floor for cost management of each activity
→ Input a major resource to each activity



Activity Resource Assignment



Master & Payment Schedule Integrated Management



[Revision Process of Master Schedule-Payment Schedule]

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Master & Payment Schedule Integrated Management

- Paid a contract payment of construction contract monthly by 90% of SPI (Schedule Performance Index = EV/SV)
→ When up to the standard, paid the payment by payment schedule
→ When below the standard, inspected actual payment by a cost consultant



5. Time (Schedule) Management

5.3. Integrated Management of Design, Procurement and Construction & Gradual Detailing of Master Schedule

Integrated Management of Design, Procurement & Construction by considering LEAD time

- Design by Fast Track
- CA work by an overseas designer (KPF) and domestic designer
- Due to Fast Track, managing drawing publication for each bid-package for procurement and early stage construction at the beginning stage; Civil works and underground structure.
- Separated management by For tender dwg. And For con dwg. of each bid package, and management of actual result by plan of each design stage SD,DD,CD

Task	Start	End	Duration	Status
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA

Progressive Elaboration of Master Schedule

- Drawing publication according to Fast Track
- Design elaboration or change by approvals and shop dwg submittal
- Schedule change management for delay or shortening occurred by construction progress

- Managing drawing publication and procurement schedule thoroughly
- Considering risk due to delay by approval of shop dwg and submittal before the commencement of construction

- Preventing delay of construction by shop dwg, submittal schedule management
- As occasion demands, coordinating contractor and designer

Task	Start	End	Duration	Status
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA
Design by Fast Track	04-01-01	04-01-01	04-01-01	NA

- Master Schedule Revision by progressive elaboration

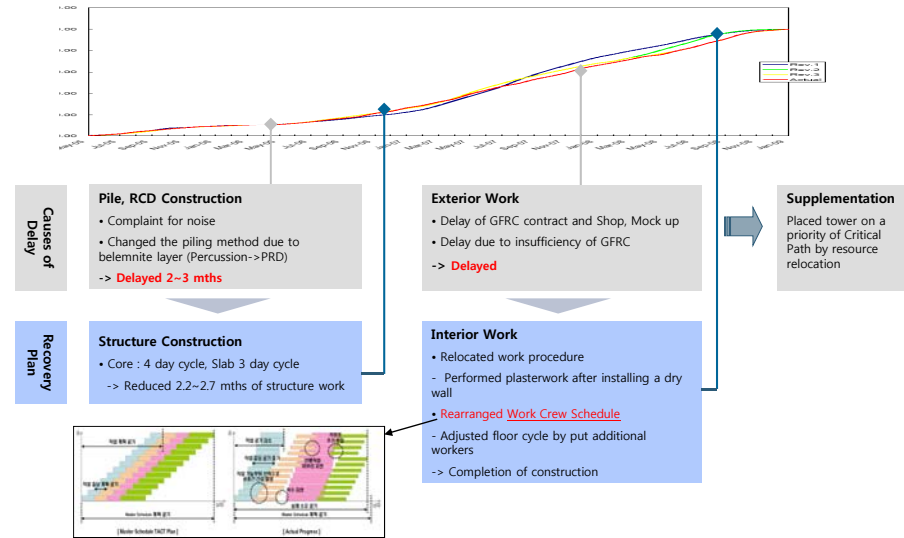
Revision No.	Approval Date	Reason for Change	Main Changed Item	Activity
Revision 0	2005.6.23	-Original rough master schedule for a contract	Master Schedule of Contract (Original)	
Revision 1	2005.11.29	-To identify detailed schedule status, making progress schedule for early management by adjusting WBS, Activity and Resource Allocation	Detailed Progress Schedule for Contract	
Revision 1.1	2006.5.17 Issued/Rejected	-Due to change of project approval schedule, the commencement date and completion of construction was changed. -Change by a delay of RCD & PHC pile construction (3.2~4.5 mths)	Commencement : 05.4.15→05.5.1 Completion : 08.12.31→09.1.31 (Total 48 mths)	
Revision 2	2006.12.28	-Complementing Rev 1.1 by negotiating with site team	Shortened 2.2 mths of structure than Rev 1.1 Exterior Finish Work: changed the start day by 15 th Jan 2007 Interior Finish Work: changed the start day by 22 nd Feb 2007	7,220
Revision 3	2008.3.24	-Fragmented middle and low rise building to manage by Work Crew Schedule	Fragmented change of critical schedule	10,110

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5. Time (Schedule) Management

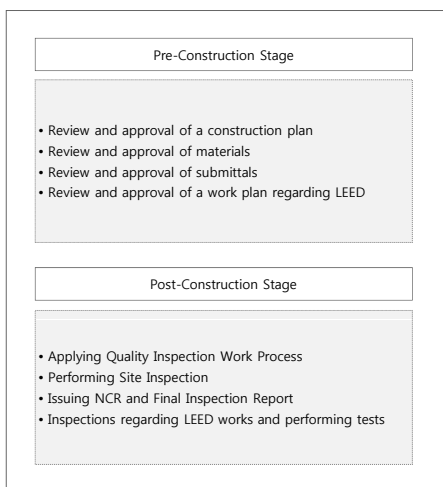
5.4. Time Management Result



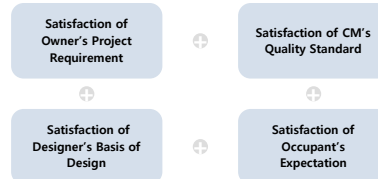
6. Quality Management

6.1. Quality Management Summary

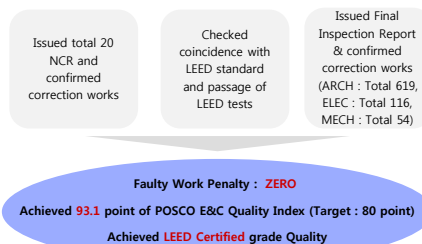
Quality Management of Pre & Post-Construction Stage



Quality Management Objective



Results of Quality Management

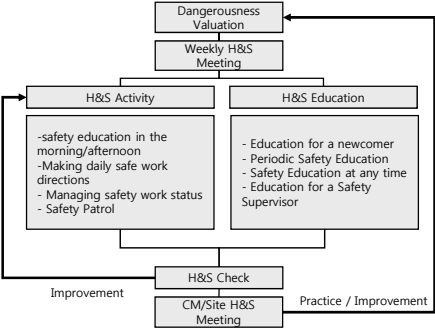


7. Health & Safety Management (KOSHA 18001)

7.1. Achieving Zero Accident Goal by SAFUN(= Safety + Fun)

Health & Safety Management System

KOSHA 18001 Operation Flow-chart



H&S Activity Cycle Management Items

- **Monthly** : Monthly H&S Union Meeting, Joint inspection and Safety Check Day Ceremony
- **Weekly** : Safety Check and Dangerousness Valuation of each zone, Weekly Safety Progress Meeting
- **Daily** : TBM, One-day Safety Work Directions, Daily Safety Meeting and Recording Safety Activities

Health & Safety Management Target and Plan

- Adopt KOSHA 18001
- Practice/Improve H&S Management by establishing a voluntary safe system of site
- Monitoring voluntary practicing as a part of life

Results of H&S Management and Awards

Achieved Zero Accident Hours

'06. 03. ~ '06. 09.	Zero Accident 1 time (1 mil Hours)
'06. 09. ~ '07. 01.	Zero Accident 2 times (2 mil Hours)
'07. 01. ~ '07. 04.	Zero Accident 3 times (3 mil Hours)
'07. 04. ~ '07. 07.	Zero Accident 4 times (4 mil Hours)
'07. 07. ~ '07. 10.	Zero Accident 5 times (5 mil Hours)
'07. 10. ~ '08. 01.	Zero Accident 6 times (6 mil Hours)

Awards

- POSCO E&C **H&S Plus site** of the second half of 2006
- POSCO E&C **The Best H&S site** of the second half of 2007

8. Other Remarkable Facts

8.1 LEED Certification (Certification of US Green Building Council)

Provide Landscape Space and Public Space

- 2 times larger landscape space than legal standard
- Environmental contribution such as providing wildlife habitat, preventing heat island effect and improving rainwater perviousness

Reduction of Greenhouse Gas (GHG)

- Provided bicycle storage for over 15% of occupants in line with Inchoen City Policy of encouraging bicycle usage
- Provided privilege parking lots for high efficiency performance cars
- Restrict usage of car and car emissions to reduce GHG emission

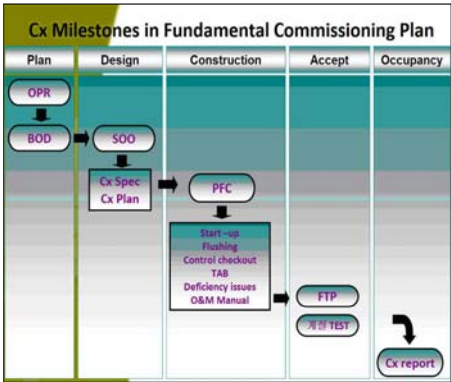
Healthy Indoor Environment

- Prevent passive smoking by pressurizing public hall
- Installed CO2 sensors at high density of population space and measuring instruments at low density of population space to provide indoor fresh air at ordinary times; preventing unnecessary energy consumption
- Constructed indoor finishes material after approving Volatile Organic Compounds (VOC) test result

Energy Reduction

- Achieve 17.4% energy cost saving effect than ASHRAE 90.1 standard building by optimizing energy performance of building
- For main energy system, carried out commissioning by a third party to achieve effects such as decreasing building management expenses, systematic documentation of building system, reconsideration of occupant's productivity and verification of system installation

LEED Commissioning Process



8. Other Remarkable Facts

8.2 Engineering Results

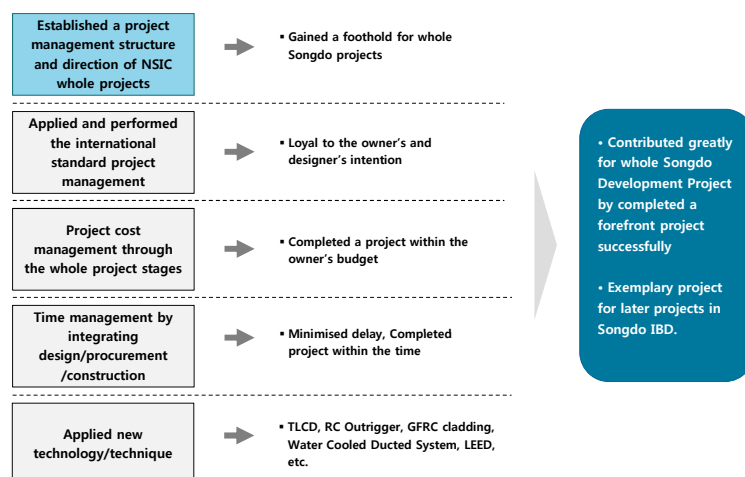
Field	Main Categories	Number of Issues	Field	Main Content	Number of Issues
Architecture	Temporary Construction (Review Crane, Concrete Equipment and etc.)	6	Electrical	Review estimated use of designed transformer	32
	Framework Construction (Review a ferro-stair and etc.)	16		Review the installing of lighting conductors at 64F of tower building	
	Foundation (Review control method of pile construction and etc.)	3		Review the installing of an unmanned postal service facility	
	Water-proof Construction (underground structure water-proof plan and etc.)	4		Review the problem of remote reading the meter system of air conditioning facilities	
	Exterior Construction (GFRC Cladding review and etc.)	37		Listed categories and etc.	
	Fishes Construction (AL heat insulating board review and etc.)	12	Mechanical	Review of water-cooled air conditioning system	38
	Generals (Review propriety of construction organisation and etc.)	13		Review of a unit FCU system	
Structure	Review an optimisation method of tower building's Link Beam	27	Civil	Review of Volume Damper system	14
	Review to optimise quantity of steel for tower building's outer column			Review of underground floor ventilation plan	
	Check the validity of applying damper system	Listed categories and etc.			
	Review slab structure system of High-Rise Building's roof	Civil	Review of RCD pile lay-out	14	
	Review slab construction and delay joint		Review of Jacket Anchor system		
	Listed categories and etc.		Listed categories and etc.		

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9. Conclusion

9.1. Summary of Project Management Results



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