

2010년 제6회 건축구조기술사대회

# 구조산업 활성화 필요성

2010. 11. 24

**정광량**  
건축구조기술사회 부회장

한국건축구조기술사회

1

## 구조설계업 현황

### 2009년 건축 공사 현황

	공사비(억원)	면적(천평)
주거용	390,777	19,158
비주거용	254,879	12,702
합계	645,657	31,860

<대한건설협회 월간건설경제동향(2010년 8월)>

### 추정 건축설계비

단위 : 억원

	공사비기준	면적기준
건축설계비	$645,657 \times 0.04 = 25,826$	-
구조설계비	$25,826 \times 0.04 = 1,033$	$31,860 \times 2,000(\text{원}) = 637$
	100%	61.7%

한국건축구조기술사회

2

## 구조설계 엔지니어 연봉 현황

· 엔지니어 수 : 334개 소 x 5인 = 1,670명 (석사학위이상 50%)

· 건설업평균연봉기준 매출 : 1,670명 x 3,000만원/년 x 2 = 1,002억

· 표준설계비기준 : 1033억 / (1670명 x 2) = 3,084 만원

(건설업 평균연봉 : 3,000만원)

· 현재설계비기준 : 637억 / (1670명 x 2) = 1,907 만원

(건설업 평균연봉의 63%)

➔ 구조설계사무소 경영부실, 구조설계사무소 취업기피

## 건축구조전공 졸업생 현황

· 전국건축구조전공 교수 : 260명 x 2명 = 520명/년

### 구조사무소 취업가능 인원

· 333개소 x 0.3명 = 약 100명

➔ 약 400명 취업대책 필요

## 구조산업활성화 필요

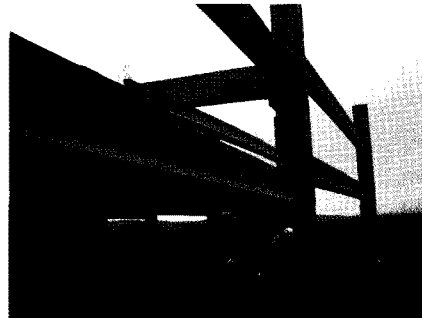
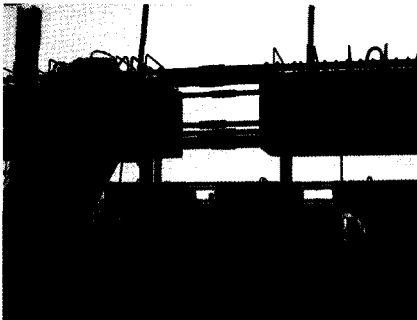
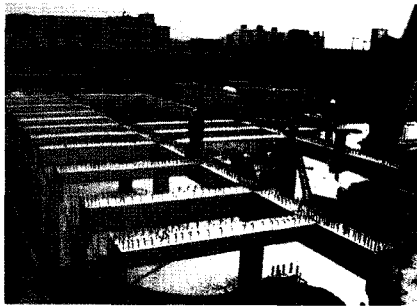
## 구조산업의 창출

- ◆ 다양한 구조공법의 개발 및 적극적인 사용이 필요
- ◆ 개발을 제조업과 연계된 산업으로 발전
- ◆ 지금까지 구조계에는 콘크리트와 철골밖에 없음

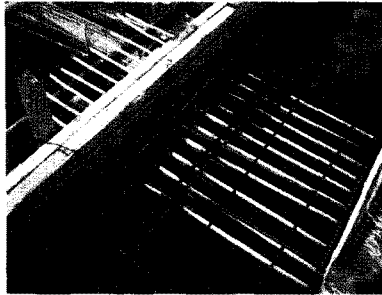
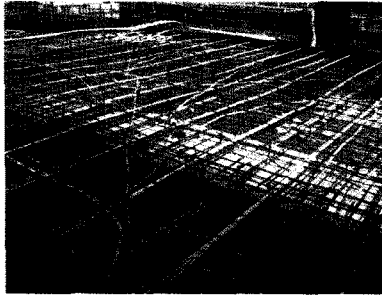


- PC, PT
- 거푸집산업
- 재료산업
- 공법개발
- 골조공사의 전문화

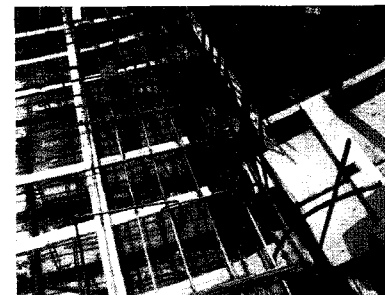
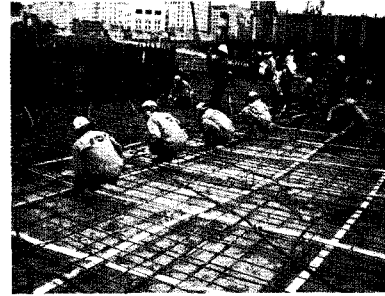
## Precast 산업



### Post-tension 산업



Unbonded Type



Bonded Type

### Formwork 산업



Table Form

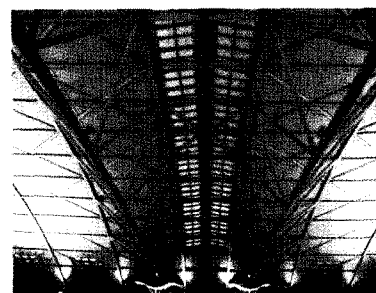


ACS

### 철골 Fabrication 산업



PEB

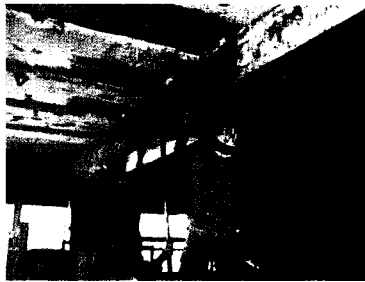


TRUSS

### 보수보강산업

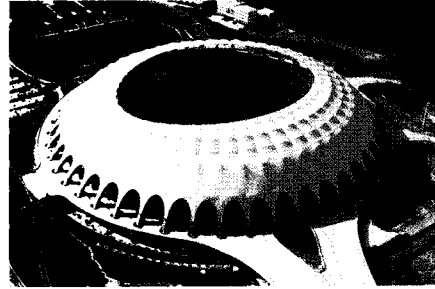


카본보강

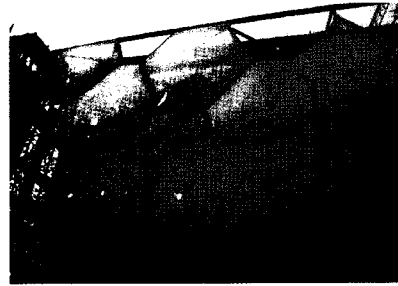


철판보강

### 특수재료산업



MEMBRANE



ETFE

한국건축구조기술사회

10

### Curtain Wall 산업



### 재료 산업



한국건축구조기술사회

11

## 설계업무의 세분화

### 현황

일반적으로 구조업무를 구조설계라 표현하며 아래의 모든 업무를 수행하였음

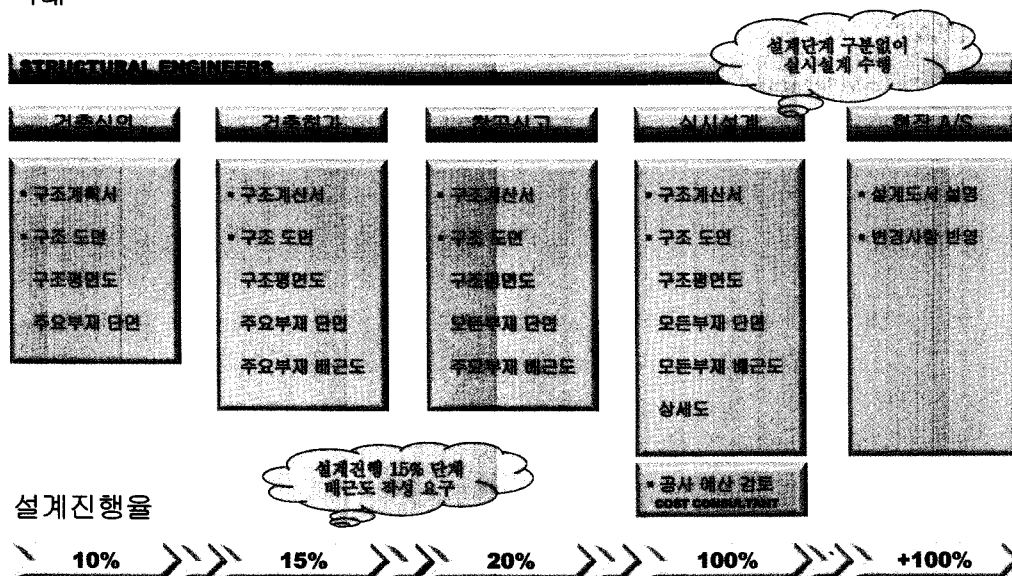
- 구조계획, 구조설계, 구조도면, 구조감리, 구조지원

→ 구조계획, 구조설계, 구조도면, 구조감리, 구조지원 등의 용어 정의 및 업무비율 세분화 필요

예) 새우깡

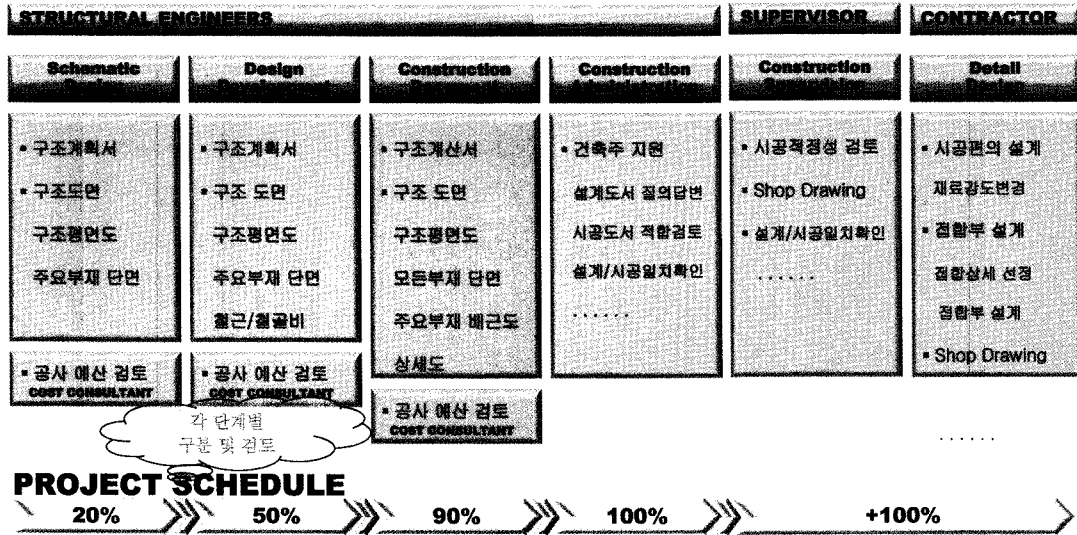
## 구조설계 단계 분류

국내



### 구조설계 단계 분류

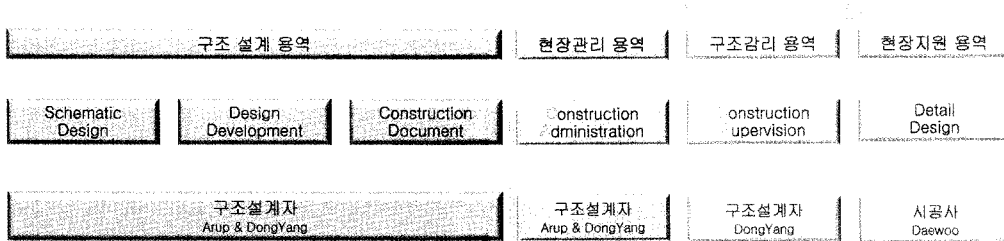
#### INTERNATIONAL



### 구조기술 용역의 분류

#### NEATT 사례

Client : Gale International Korea



What is the CA?

**Construction Administration**

1. **Bid Review**
2. **RFI(Request for Information) Response**
3. **Answer all relevant structural field question**
4. **Coordinate, Assist and Consult with PM**
5. **Review Shop Drawings submitted by the Contractor**
6. **Review Caculation by the Contractor's Engineer**
7. **Field Visits at intervals appropriate to the stage of Construction**
8. **Endeavor to guard the Owner against defects and deficiencies in the work**
9. **Attend Construction Meeting If, necessary**

**구조설계업무**

업무진행 단계에 따른 비율 및 현황

구조설계 단계	계획설계 SD Schematic Design	기본설계 DD Design Development	실시설계 CD Construction Documents	현장지원 CA Construction Administration	공사감리 CS Construction Supervision
비율	20%	30%	40%	10%	
현황 (기존 구조설계 업무영역)	→				
제안 (세분화에 따른 새로운 영역)	→				* 신규업역창출

\* CE (Construction Engineering)  
시공+구조 지원 업무



## 구조설계 표현의 일반화

**현황**

구조기술자 (검토자) 중심의 표현  
 구조계산 위주  
 주로 Midas 출력물 (90%)  
 2D Based CAD , Sketch

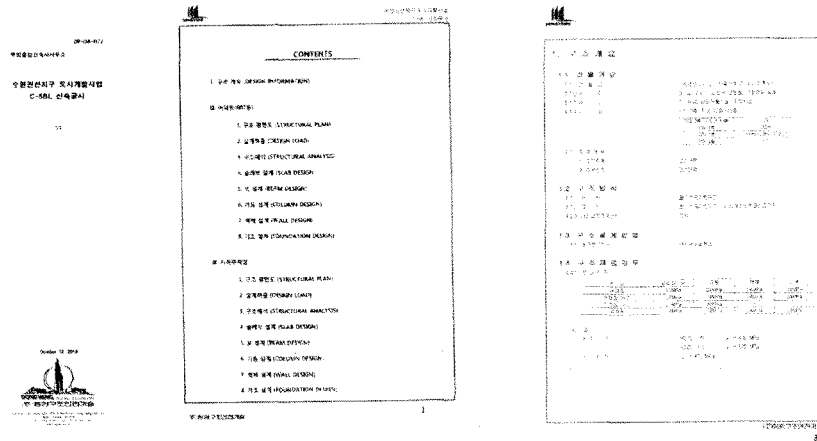


구매자(건축가, 시공자, 건축주) 중심의 표현  
 건축가 : Structural Design (Graphic)  
 시공자 : 공법 및 공기  
 건축주 : Cost 및 Marketing

## 국내구조설계사

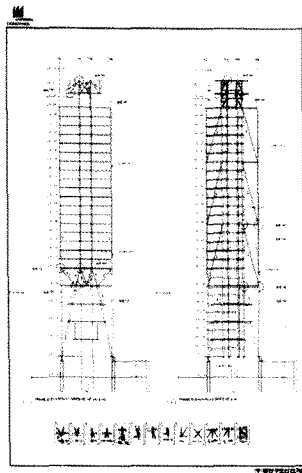
### Example : Calculation Sheet

구조계산 위주의 계산서



Calculation Sheet

구조계산 위주의 계산서



NO.	SECTION	START	END
1	1F	100	100
2	2F	100	100
3	3F	100	100
4	4F	100	100
5	5F	100	100
6	6F	100	100
7	7F	100	100
8	8F	100	100
9	9F	100	100
10	10F	100	100
11	11F	100	100
12	12F	100	100
13	13F	100	100
14	14F	100	100
15	15F	100	100
16	16F	100	100
17	17F	100	100
18	18F	100	100
19	19F	100	100
20	20F	100	100
21	21F	100	100
22	22F	100	100
23	23F	100	100
24	24F	100	100
25	25F	100	100
26	26F	100	100
27	27F	100	100
28	28F	100	100
29	29F	100	100
30	30F	100	100
31	31F	100	100
32	32F	100	100
33	33F	100	100
34	34F	100	100
35	35F	100	100
36	36F	100	100
37	37F	100	100
38	38F	100	100
39	39F	100	100
40	40F	100	100
41	41F	100	100
42	42F	100	100
43	43F	100	100
44	44F	100	100
45	45F	100	100
46	46F	100	100
47	47F	100	100
48	48F	100	100
49	49F	100	100
50	50F	100	100
51	51F	100	100
52	52F	100	100
53	53F	100	100
54	54F	100	100
55	55F	100	100
56	56F	100	100
57	57F	100	100
58	58F	100	100
59	59F	100	100
60	60F	100	100
61	61F	100	100
62	62F	100	100
63	63F	100	100
64	64F	100	100
65	65F	100	100
66	66F	100	100
67	67F	100	100
68	68F	100	100
69	69F	100	100
70	70F	100	100
71	71F	100	100
72	72F	100	100
73	73F	100	100
74	74F	100	100
75	75F	100	100
76	76F	100	100
77	77F	100	100
78	78F	100	100
79	79F	100	100
80	80F	100	100
81	81F	100	100
82	82F	100	100
83	83F	100	100
84	84F	100	100
85	85F	100	100
86	86F	100	100
87	87F	100	100
88	88F	100	100
89	89F	100	100
90	90F	100	100
91	91F	100	100
92	92F	100	100
93	93F	100	100
94	94F	100	100
95	95F	100	100
96	96F	100	100
97	97F	100	100
98	98F	100	100
99	99F	100	100
100	100F	100	100

midas Gen		Steel Checking Result	
Category	Item	Value	Limit
<b>1. Design Information</b>			
Design Code	AISC 360-10		
Design Method	LRFD		
Design Type	Beam		
Design Name	Beam-1		
Design Length	12000		
<b>2. Member Forces</b>			
Member ID	1	2	3
Max. Moment	100000	200000	300000
Max. Shear	10000	20000	30000
Max. Axial	1000000	2000000	3000000
Max. Torsion	10000	20000	30000
<b>3. Design Parameters</b>			
Design Strength	1000000	2000000	3000000
Design Shear	100000	200000	300000
Design Axial	1000000	2000000	3000000
Design Torsion	10000	20000	30000
<b>4. Strength Checking Results</b>			
Check Item	Value	Limit	Result
Flexure	0.8	1.0	OK
Shear	0.5	1.0	OK
Compression	0.7	1.0	OK
Torsion	0.2	1.0	OK
Interaction	0.9	1.0	OK

Arup

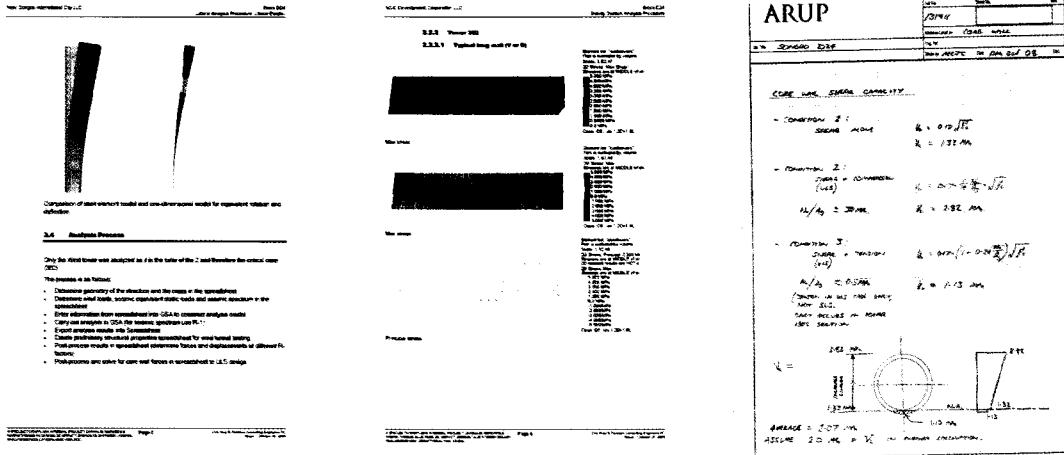
Calculation Report : 보고서로 표현

NSRC Development Corporation LLC		Block D24	
Quality System Analysis Procedure		Quality System Analysis Procedure	
<b>Contents</b>			
1	Analysis	Page	
1.1	Determination of applied PT force & ULS Design Load Effect	1	
1.2	Steel beam shear check at mid	1	
1.3	FE Shear moment	1	
1.4	Deflection	1	
2	Design Results and FE Analysis	4	
2.1	Concrete Top Analysis	4	
2.2	Concrete Shear on Concrete	14	
2.3	Floor Diaphragm Forces	15	
3	Beam Shear Analysis	23	
4	Design Results	24	
5	Displacement Results	25	
6	Displacement Drifting Analysis	26	

NSRC Development Corporation LLC		Block D24	
Quality System Analysis Procedure		Quality System Analysis Procedure	
<b>1 Analysis</b>			
<b>1.1 Determination of applied PT force &amp; ULS Design Load Effect</b>			
Results			
The specification			
Description of the calculation method			
In general, PT force is determined by the working load & supported dead load. In the ultimate case, the steel beam also needs to support the design load.			
<b>1.2 Steel beam shear check at mid</b>			
The specification			
Description of the calculation method			
It is recommended that the concrete shear on the FE design force of the design load is used to check the shear force on the concrete beam.			
<b>1.3 FE Shear moment</b>			
Results			
Description of the calculation method			
It is recommended that the concrete shear on the FE design force of the design load is used to check the shear force on the concrete beam.			
<b>1.4 Deflection</b>			
Results			
Description of the calculation method			
The deflection is determined by the FE result and the concrete shear on the design load. These are determined using the design load. They are determined using the design load to check the deflection of the beam.			
The steel beam shear force is determined by the design load and the concrete shear on the design load. They are determined using the design load to check the shear force on the concrete beam.			
When the steel beam shear force is determined by the design load and the concrete shear on the design load, they are determined using the design load to check the shear force on the concrete beam.			

# Arup

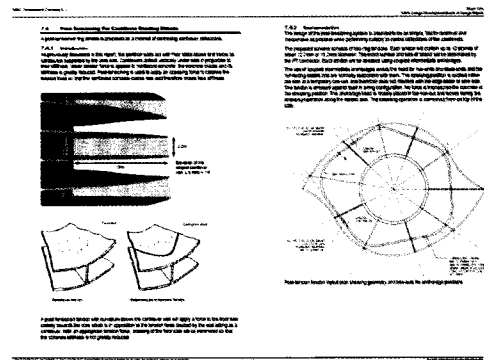
## Example : Calculation Report



### Calculation Report

# Arup

- 설계자가 이해할 수 있도록 표현
- 기본개념 Sketch와 Graphic으로 표현



### Report

Arup

시공자를 위한 공법설명

건축주를 위한 cost비교

Thornton Tomasetti

Example : Calculation Report

Cover

Contents

Calculation

# Thornton Tomasetti

## Example : Calculation Report

Thornton Tomasetti

### C. STRUCTURAL SYSTEM PERFORMANCE SUMMARY

ETABS 3D finite element model was utilized for lateral load-resisting system. Default nonlinear Concrete member ender properties are provided to account for the effects of cracking in per ACI 318.1R strength and serviceability requirements.

For secondary member properties, see enclosed "B" Report.

For strength design section properties are reduced as follows:

SEISMIC	1.00
WIND	1.00

For strength design section properties are reduced as follows:

SEISMIC	1.00
WIND	1.00

For strength design section properties are reduced as follows:

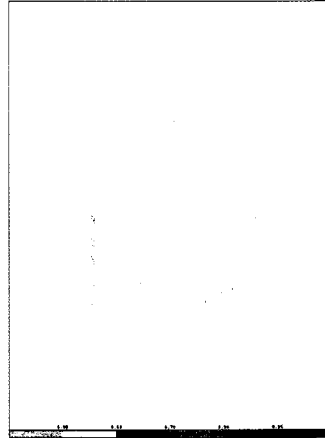
SEISMIC	1.00
WIND	1.00

For strength design section properties are reduced as follows:

SEISMIC	1.00
WIND	1.00

DR KING STRUCTURAL CALCULATION FEBRUARY 13, 2014 - Page 9 of 10

ETABS



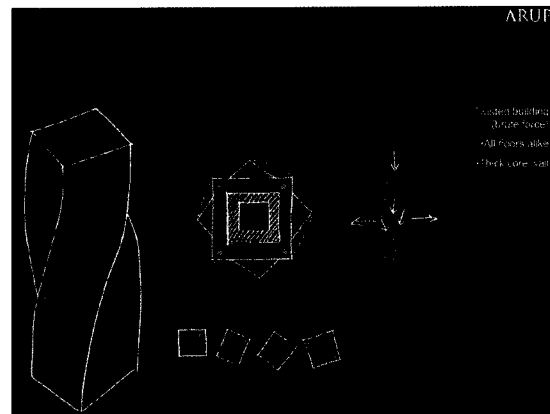
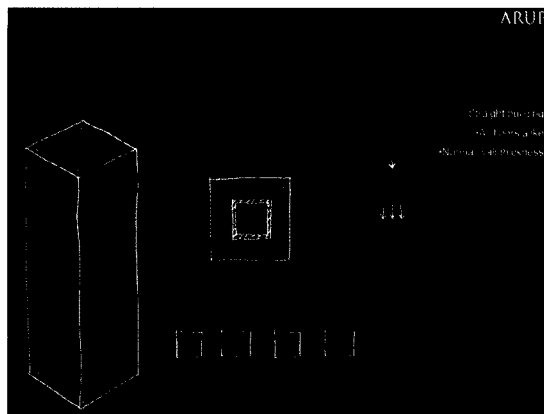
ETABS 3D Design

Member ID	Member Type	Section	Area (mm <sup>2</sup> )	Iy (mm <sup>4</sup> )	Iz (mm <sup>4</sup> )	J (mm <sup>4</sup> )	Wx (mm)	Wy (mm)	Wz (mm)
1	Column	400x400	156000	1.067e+10	1.067e+10	1.067e+10	200	200	200
2	Beam	400x400	156000	1.067e+10	1.067e+10	1.067e+10	200	200	200
3	Beam	400x400	156000	1.067e+10	1.067e+10	1.067e+10	200	200	200

## Calculation Report

# Arup

## Example : Presentation



## 건축주, 건축사, 시공사 간의 상호이해를 위한 소통방법 부족

현재 구조계산서만의 결과물로서는  
구조디자인 및 기술의 전달 및 평가 불가능



- Conversation Method 교육 필요 (글, 그림, Presentation:3D)
- 기술자의 Graphic Design Technic 필요 (SketchUp, BIM 등)
- 견적 및 현장참여를 통한 시공분야의 이해 필요
- Marketing 분야에 대한 기초교육 필요