



*Week 7*

# **Project Cost Estimating (1)**

**457.307 Construction Planning and Management**  
Department of Civil and Environmental Engineering  
Seoul National University

**Prof. Seokho Chi**

[shchi@snu.ac.kr](mailto:shchi@snu.ac.kr)

건설환경공학부 35동 304호

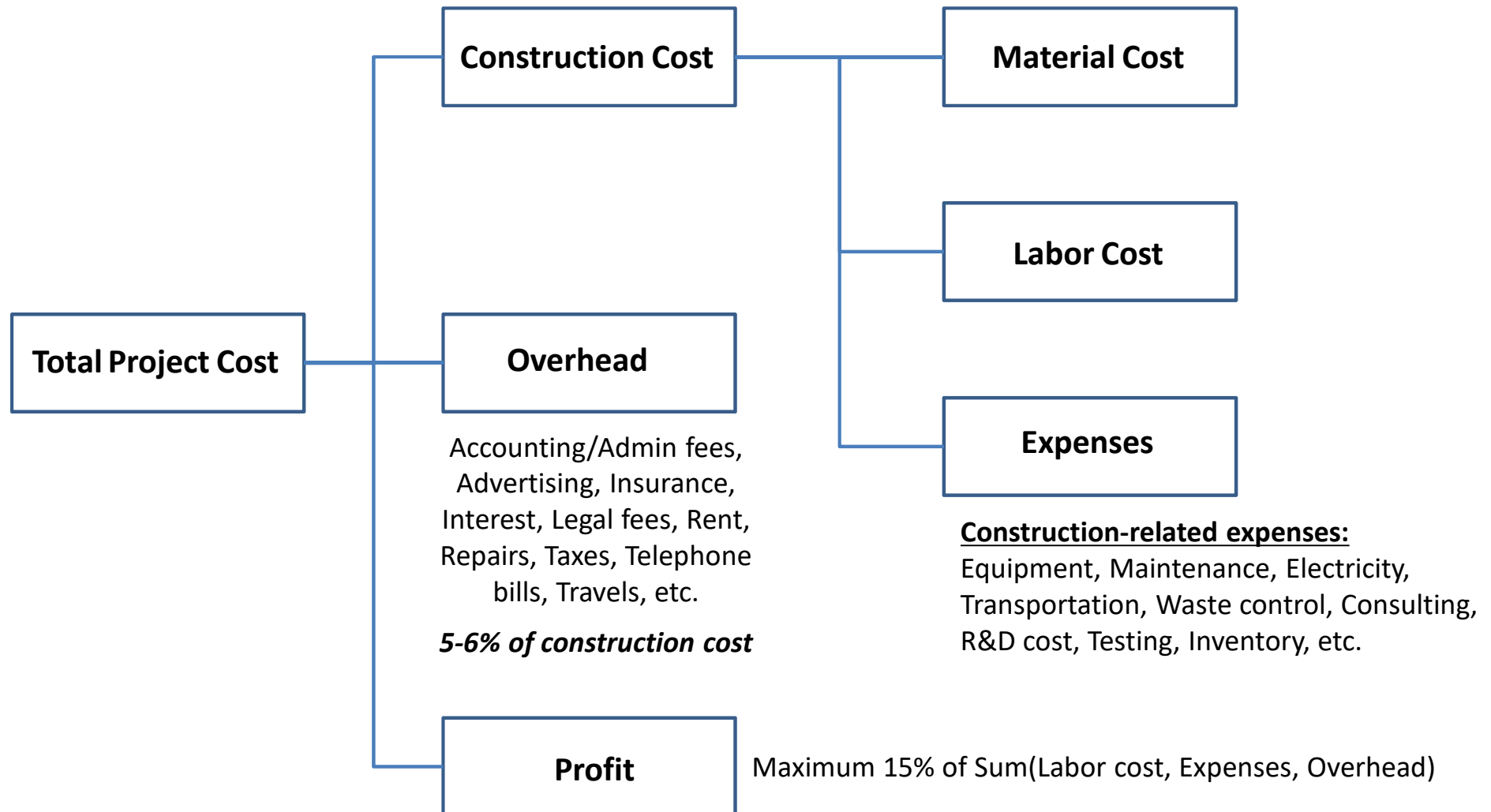
# Estimating Construction Costs

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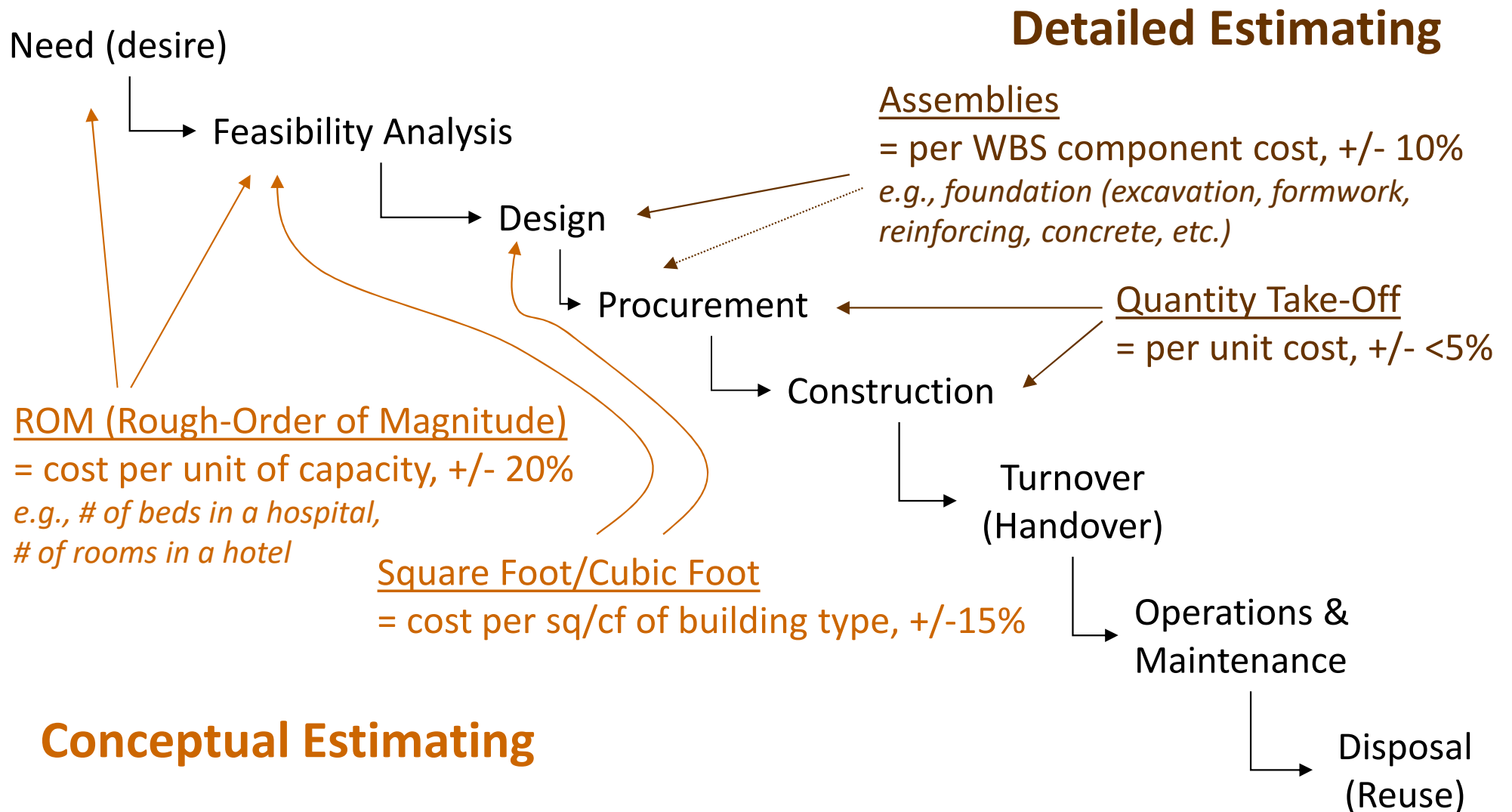
- Approaches to estimating
- Conceptual / Detailed estimating
- RS Means data and examples
- Estimates
  - Necessary to guide decisions, budgets
  - Hard to do well
  - Are performed by several actors
    - Owners
    - Designers
    - Contractors
    - Subcontractors

# Bid Estimate

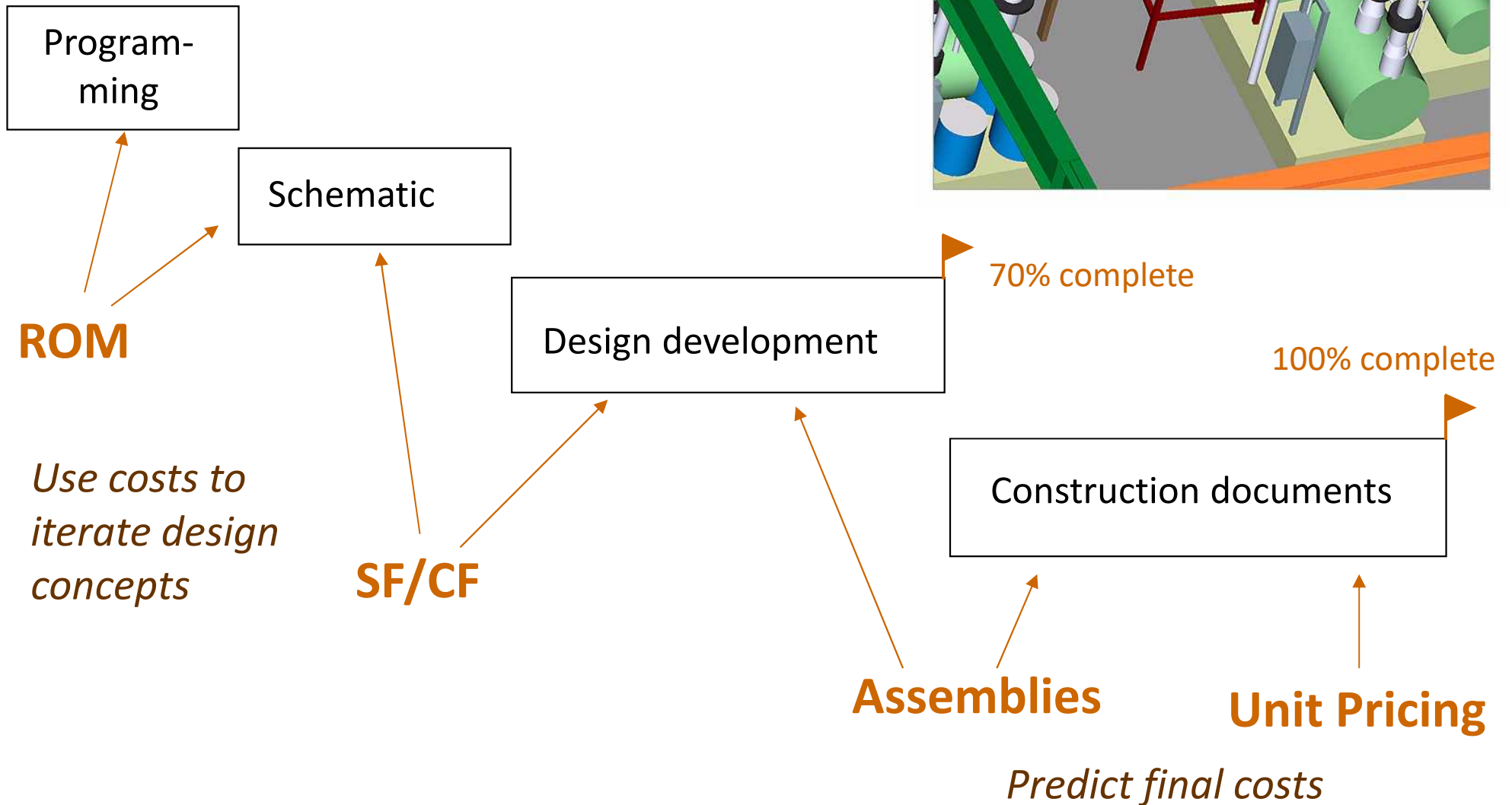
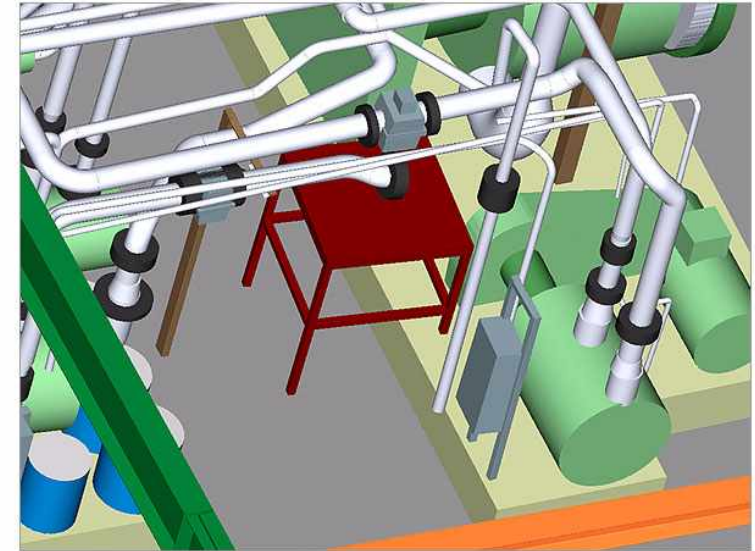
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# Context: Project Timeline



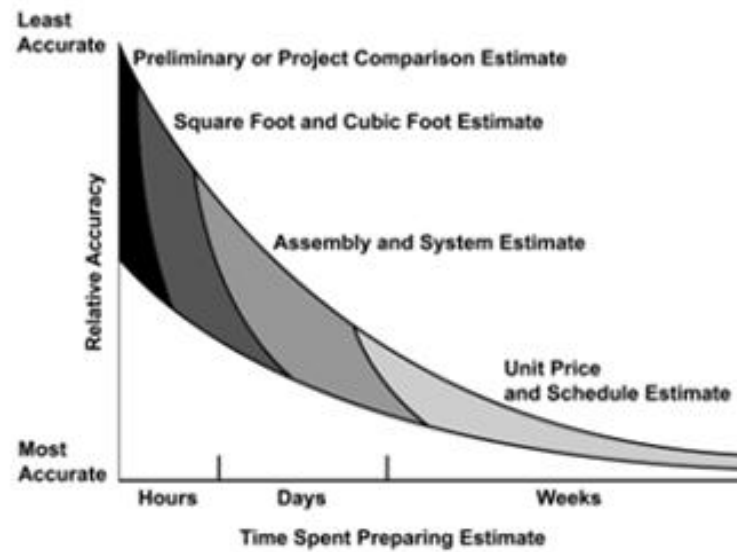
# Design



# Cost Estimating

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- Preparation Time X Accuracy



# Conceptual Estimating

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- Guide decisions regarding: location, scope, feasibility.
- Very little project information is available
- Size of the project is generally known, although it may be described in terms of capacity (e.g.: number of beds, megawatts)
- Short preparation time
- Estimates prepared for many different program options

# Detailed Estimating

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- Based on a (near) complete set of documents
- Owner team prepares an estimate to negotiate
- Contractors prepare an estimate to bid (or negotiate)
- Price given by contractors for different work packages may be based on bids from pre-qualified subcontractors



# Conceptual Estimating

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- **Consideration**
  - Building type
  - Location
  - Rough size
  - Material type
  - Time
- **Compare to historical data (similar buildings)**
  - Apply modifiers as needed

# Bid Estimate

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- **Resources for Estimate**
  - U.S.
    - RS Means Building Construction Cost Data
    - RS Means Assemblies Cost Data
    - RS Means Square Foot Costs
  - Australia
    - Rawlinsons Construction Cost Guide

# Building Costs

## RS Means Building Data

- Compiles info
- Good starting point
- Firm data often better (why?)

*More Competitive*

### Example:

Library - 6,500 sf

*RS Means - \$97.30/sf*

Estimated cost : \$632,450

*If ¼, 25% of that type of building costs less than the indicated price and 75% costs more*

141   S.F., C.F. and % of Total Costs											
14.1   S.F. & C.F. Costs				UNIT	UNIT COSTS			% OF TOTAL			
					1/4	MEDIAN	3/4	1/4	MEDIAN	3/4	
520	3100	Total: Mechanical & Electrical	R141-010	S.F.	36	63.85	75.55	29.20%	31.10%	34.10%	520
530	0010	LIBRARIES		S.F.	76.40	97.30	124				530
	0020	Total project costs		C.F.	5.35	6.70	8.65				
	0500	Masonry		S.F.	4.37	9.75	16.80	5.80%	9.50%	11.90%	
	1800	Equipment			1.11	2.98	4.65	1.20%	2.80%	4.50%	
	2720	Plumbing			3.09	4.35	5.90	3.60%	4.90%	5.70%	
	2770	Heating, ventilating, air conditioning			6.60	11.20	14.60	8%	11%	14.60%	
	2900	Electrical			7.85	10.15	12.60	8.30%	11%	12.10%	
	3100	Total: Mechanical & Electrical			22.65	30.95	38.75	18.90%	25.30%	27.60%	
550	0010	MEDICAL CLINICS		S.F.	75.20	93.15	117				550
	0020	Total project costs		C.F.	5.60	7.25	9.70				
	1800	Equipment		S.F.	2.06	4.33	6.75	1.80%	5.20%	7.40%	
	2720	Plumbing			5.05	7.15	9.55	6.10%	8.40%	10%	
	2770	Heating, ventilating, air conditioning			6.15	7.90	11.65	6.70%	9%	11.30%	
	2900	Electrical			6.40	9.10	12.05	8.10%	10%	12.20%	
	3100	Total: Mechanical & Electrical			20.10	28.25	39.50	22%	27.60%	34.30%	
	3500	See also division 11700									
570	0010	MEDICAL OFFICES		S.F.	70.60	87.50	108				570
	0020	Total project costs		C.F.	5.25	7.20	9.85				
	1800	Equipment		S.F.	2.45	4.70	6.70	3%	5.80%	7.20%	
	2720	Plumbing			3.96	6.10	8.30	5.70%	6.80%	8.60%	
	2770	Heating, ventilating, air conditioning			4.79	7.05	9.10	6.20%	8%	9.70%	
	2900	Electrical			5.60	8.15	11.40	7.60%	9.80%	11.40%	
	3100	Total: Mechanical & Electrical			13.90	20	29.70	18.50%	22%	24.90%	
590	0010	MOTELS		S.F.	45.20	67	86.40				590
	0020	Total project costs		C.F.	3.85	5.55	9.10				
	2720	Plumbing		S.F.	4.59	5.85	6.95	9.40%	10.60%	12.50%	
	2770	Heating, ventilating, air conditioning			2.79	4.17	7.45	5.60%	5.60%	10%	
	2900	Electrical			4.27	5.45	7.10	7.10%	8.20%	10.40%	
	3100	Total: Mechanical & Electrical			14.50	18.20	31.20	18.50%	21%	24.40%	
	5000										
	9000	Per rental unit, total cost		Unit	23,000	43,800	47,300				
	9500	Total: Mechanical & Electrical			4,500	6,800	7,900				
600	0010	NURSING HOMES		S.F.	68	89.95	110				600
	0020	Total project costs		C.F.	5.45	7	9.50				
	1800	Equipment		S.F.	2.28	3.04	4.90	2.40%	3.70%	6%	
	2720	Plumbing			6.40	8.15	11.30	9.40%	10.70%	14.20%	
	2770	Heating, ventilating, air conditioning			6.35	8.85	11.30	9.30%	11.40%	11.80%	
	2900	Electrical			7.05	8.80	11.80	9.70%	11%	13%	
	3100	Total: Mechanical & Electrical			16.75	23.45	34.35	26%	29.90%	30.50%	
	3200										
	9000	Per bed or person, total cost		Bed	29,400	36,200	48,200				
610	0010	OFFICES Low Rise (1 to 4 story)		S.F.	57.30	73	97.15				610
	0020	Total project costs		C.F.	4.15	5.80	7.85				
	0100	Site work		S.F.	4.32	7.35	11.40	5.30%	9.70%	14%	
	0500	Masonry			1.99	4.66	8.80	2.90%	5.80%	8.70%	
	1800	Equipment			.71	1.30	3.57	1.20%	1.50%	4%	
	2720	Plumbing			2.18	3.30	4.67	3.70%	4.50%	6.10%	
	2770	Heating, ventilating, air conditioning			4.71	6.50	9.65	7.20%	10.50%	11.90%	
	2900	Electrical			4.86	6.70	9.40	7.50%	9.60%	11.10%	
	3100	Total: Mechanical & Electrical			11.40	15.85	23.15	18%	21.80%	26.50%	
620	0010	OFFICES Mid Rise (5 to 10 story)		S.F.	63.20	76.65	104				620
	0020	Total project costs		C.F.	4.42	5.60	8.10				
	2720	Plumbing		S.F.	1.91	2.96	4.26	2.80%	3.70%	4.50%	
	2770	Heating, ventilating, air conditioning			4.80	6.85	10.95	7.60%	9.40%	11%	

Figure 5.1

Sample square foot costs for various structures.

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## City Cost Indexes

R13.3-010

## Building Systems

DIV. NO.	BUILDING SYSTEMS	NEW YORK														
		HICKSVILLE			NEW YORK			RIVERHEAD			ROCHESTER			SCHENECTADY		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
1-2	FOUND/SUBSTRUCTURES	98.0	154.0	133.7	120.3	157.0	143.7	97.5	153.3	133.0	100.0	102.1	101.3	94.8	99.0	97.5
3	SUPERSTRUCTURES	105.8	151.1	125.5	111.5	154.2	130.0	106.0	149.7	125.0	101.6	106.0	103.5	99.5	103.2	101.1
4	EXTERIOR CLOSURE	111.9	157.6	133.8	119.9	161.0	139.6	114.4	157.3	135.0	107.6	101.6	104.7	103.4	97.8	100.7
5	ROOFING	105.9	150.3	125.3	108.0	155.0	128.5	106.0	150.3	125.4	100.8	99.4	100.2	92.5	95.5	93.8
6	INTERIOR CONSTRUCTION	97.5	151.9	119.8	103.5	167.7	129.8	97.8	151.9	120.0	96.7	99.0	97.6	97.5	88.3	93.7
7	CONVEYING	100.0	129.8	108.4	100.0	143.2	112.2	100.0	123.4	106.6	100.0	99.1	99.7	100.0	97.0	99.1
8	MECHANICAL	99.8	150.6	122.9	100.4	161.4	128.0	99.8	150.6	122.8	100.0	93.4	97.0	100.4	93.3	97.2
9	ELECTRICAL	103.3	159.8	141.8	112.0	177.7	156.8	104.4	159.8	142.2	107.0	95.2	99.0	103.3	96.1	98.4
11	SPECIAL CONSTRUCTION	100.0	162.9	104.0	100.0	172.3	104.6	100.0	162.7	104.0	100.0	97.7	99.9	100.0	88.4	99.3
12	SITE WORK	119.1	132.8	129.3	142.2	128.8	132.2	119.7	131.5	128.5	77.6	107.2	99.6	73.8	108.1	99.4
1-12	WEIGHTED AVERAGE	102.9	151.8	126.6	108.6	160.5	133.8	103.4	151.2	126.6	100.6	99.7	100.1	99.0	96.9	98.0

DIV. NO.	BUILDING SYSTEMS	FLORIDA														
		PANAMA CITY			PENSACOLA			ST. PETERSBURG			TALLAHASSEE			TAMPA		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
1-2	FOUND/SUBSTRUCTURES	103.5	53.6	71.7	102.5	69.7	81.6	105.3	69.6	82.6	100.3	62.7	76.4	103.9	69.7	82.1
3	SUPERSTRUCTURES	98.2	57.6	80.6	97.4	75.3	87.8	101.9	76.4	90.8	99.2	69.9	86.5	102.4	76.5	91.2
4	EXTERIOR CLOSURE	94.8	36.2	66.6	92.9	62.9	78.5	106.3	61.4	84.7	89.2	50.4	70.6	88.7	61.5	75.6
5	ROOFING	97.3	36.6	70.8	97.0	61.5	81.5	96.6	57.2	79.4	97.1	55.6	79.0	97.0	58.4	80.1
6	INTERIOR CONSTRUCTION	101.7	31.1	72.7	100.3	62.2	84.7	101.3	58.2	83.6	102.9	46.5	79.8	102.9	58.2	84.6
7	CONVEYING	100.0	61.7	89.2	100.0	65.0	90.1	100.0	69.4	91.4	100.0	76.2	93.3	100.0	77.2	93.6
8	MECHANICAL	99.9	31.3	68.9	99.9	62.3	82.9	99.9	62.1	82.8	99.9	49.6	77.1	99.9	62.2	82.8
9	ELECTRICAL	94.1	41.4	58.2	99.5	61.9	73.9	96.3	59.7	71.4	96.4	51.2	65.6	95.3	59.8	71.1
11	SPECIAL CONSTRUCTION	100.0	33.3	95.7	100.0	61.9	97.6	100.0	56.9	97.2	100.0	45.2	96.5	100.0	56.9	97.2
12	SITE WORK	135.2	84.6	97.5	132.8	86.9	98.6	122.0	86.6	95.6	121.9	86.3	95.4	121.9	86.6	95.6
1-12	WEIGHTED AVERAGE	99.8	44.6	73.1	99.4	67.0	83.7	101.8	65.9	84.4	99.3	57.4	79.0	100.0	66.2	83.6

DIV. NO.	BUILDING SYSTEMS	NEVADA														
		CARSON CITY			LAS VEGAS			RENO			MANCHESTER			NASHUA		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
1-2	FOUND/SUBSTRUCTURES	108.4	100.5	103.3	103.1	109.8	107.4	108.5	101.4	104.0	100.9	87.7	92.5	99.6	87.7	92.0
3	SUPERSTRUCTURES	105.9	100.5	103.6	104.9	108.7	106.6	106.4	102.5	104.7	100.3	85.4	93.9	100.0	85.4	93.6
4	EXTERIOR CLOSURE	118.2	89.0	104.1	115.5	102.8	109.4	118.3	88.9	104.1	106.0	94.8	100.6	106.2	94.8	100.7
5	ROOFING	104.0	92.6	99.0	103.7	104.0	103.8	104.1	92.6	99.1	100.5	97.1	99.0	100.8	97.1	99.2
6	INTERIOR CONSTRUCTION	96.6	94.8	95.8	97.2	107.9	101.6	97.3	95.1	96.4	102.5	79.0	92.9	102.6	79.0	92.9
7	CONVEYING	100.0	129.4	108.3	100.0	115.6	104.4	100.0	129.4	108.3	100.0	100.8	100.2	100.0	100.8	100.2
8	MECHANICAL	100.0	97.9	99.0	100.0	112.7	105.7	100.0	98.0	99.1	99.9	82.9	92.2	99.9	82.9	92.2
9	ELECTRICAL	93.7	91.7	92.3	95.8	108.2	104.2	93.7	91.7	92.3	104.6	75.8	85.0	104.4	75.8	84.9
11	SPECIAL CONSTRUCTION	100.0	95.7	99.7	100.0	105.9	100.4	100.0	95.7	99.7	100.0	67.9	97.9	100.0	67.9	97.9
12	SITE WORK	67.2	102.6	93.6	67.2	104.0	94.6	67.5	102.6	93.7	94.6	96.5	96.0	96.6	96.5	96.5
1-12	WEIGHTED AVERAGE	102.0	96.9	99.5	101.5	108.3	104.8	102.2	97.3	99.9	101.5	85.1	93.6	101.5	85.1	93.6

100 = National Average

MAT: Material Cost, INST: Labor Cost

Figure 5.4

City cost indices for selected cities.

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# (1) ROM Estimate

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- 100-bed dormitory (low rise); median quality; 2003 data; in Nashville, TN; Jan 2003 construction start
  - Total cost = Number of units  $\times$  Unit cost
    - = 100 units  $\times$  36,300 per unit
    - = \$3,630,000 (**without adjustments**)
- Location Adjustment
  - National average city index = 100
  - Adjusted cost for a city = Estimated cost  $\times$  City index / 100
  - For Nashville: 86.2
  - Adjusted total cost = \$3,630,000  $\times$  86.2 / 100
    - = \$3,129,060

## (2) SF Estimate – Modeled

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- 19,386 ft<sup>2</sup> fire station; face brick with concrete block back-up; steel joists; 2003 data; in Austin; January 2005 construction start; 2.5% projected increase per year.
  - Total cost = Size in ft<sup>2</sup> × Cost/ft<sup>2</sup>  
= 19,386 ft<sup>2</sup> × \$97.95/ft<sup>2</sup> (approximately)  
= \$1,898,858 (without adjustments)

## (2) SF Estimate – Modeled (Cont'd)

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- **Add-on Features:**

- Combination range, refrigerator, sink, microwave oven & icemaker (quantity = 1) =  $1 \times \$5,275$
- Steel lockers, single tier, 72" (8 openings) =  $8 \times \$200$

- **Cost with add-on features = \$ 1,905,733**

- **Key point**

- Estimates can mix level of detail
  - If you find, you can add now
- Danger is to double count
  - You need to figure out which one has been included already through itemized building code
  - Clearly determine included/not-included items

## (2) SF Estimate – Modeled (Cont'd)

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- **Location Adjustment**

- National average city index = 100
- Adjusted cost for a city = Estimated cost  $\times$  City index / 100
- For Austin
  - Adjusted Austin cost = \$ 1,905,733  $\times$  79.7 / 100  
= **\$1,518,869**



## (2) SF Estimate – Modeled (Cont'd)

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- Time Adjustment

- 2003 data used for 2005 construction

- Time adjusted cost =  $(1 + \% \text{ projected yearly increase})^n \times$   
Adjusted Cost

$$= (1 + 0.025)^2 * \$1,518,869$$

$$= \underline{\underline{\$1,595,761}}$$

# Detailed Estimating

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- **Scope definition**
  - Dimensions, specified quality, construction methodology, potential problems and solutions
- **Quantity take off**
  - Packaging of project components' scope into units that can be priced
- **Pricing**
  - Applying marketplace labor, material, and equipment costing to the quantities
  - Factors such as schedule, construction process, productivity, labor agreements, and resource allocation should be considered
- **Overhead and profit issues**
  - Overhead, profit, sales taxes, labor benefits, bond, and contingency

# Scope Definition

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- **Contract documents**
  - Drawings
  - Specifications
  - Technical references
  - Addenda
- **Site analysis**
  - Soil
  - Utilities
  - Access
  - Neighbors
  - Existing structures
- **New construction vs. Repair and remodeling**
- **Bonding and insurance requirements**

# Basic Detailed Process

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- **Estimated Cost =**

Quantity  $\times$  Price (material + installation) per unit

- Quantity: by counting
- Price: by time, materials, and crew cost
  - Materials: vendor data
  - Crew cost: varies by composition of junior and senior members as well as size; also equipment
  - Time (duration): by productivity per unit
    - » Can vary a lot by method, crew size

# Estimate Setup

- Format / Organization of cost items
  - Typically by CSI codes
- Separation of subcontractors from in-house work
- Adjustments
- Overhead and profit (markup) summary

<b>03 15 00</b>	<b>Concrete Accessories</b>
03 15 13	Waterstops
03 15 13.13	Non-Expanding Waterstops
03 15 13.16	Expanding Waterstops
03 15 13.19	Combination Expanding and Injection Hose Waterstops
03 15 13.21	Injection Hose Waterstops
03 15 16	Concrete Construction Joints
03 15 19	Cast-In Concrete Anchors
<b>03 20 00</b>	<b>Concrete Reinforcing</b>
<b>03 21 00</b>	<b>Reinforcement Bars</b>
03 21 11	Plain Steel Reinforcement Bars
03 21 13	Galvanized Reinforcement Steel Bars
03 21 16	Epoxy-Coated Reinforcement Steel Bars
03 21 19	Stainless Steel Reinforcement Bars
03 21 21	Composite Reinforcement Bars
03 21 21.11	Glass Fiber-Reinforced Polymer Reinforcement Bars
03 21 21.13	Organic Fiber-Reinforced Polymer Reinforcement Bars
03 21 21.16	Carbon Fiber-Reinforced Polymer Reinforcement Bars
<b>03 22 00</b>	<b>Fabric and Grid Reinforcing</b>
03 22 13	Galvanized Welded Wire Fabric Reinforcing
03 22 16	Epoxy-Coated Welded Wire Fabric Reinforcing
03 22 19	Composite Grid Reinforcing
<b>03 23 00</b>	<b>Stressed Tendon Reinforcing</b>
<b>03 24 00</b>	<b>Fibrous Reinforcing</b>
<b>03 25 00</b>	<b>Composite Reinforcing</b>
03 25 13	Glass Fiber-Reinforced Polymer Reinforcing
03 25 16	Organic Fiber-Reinforced Polymer Reinforcing
03 25 19	Carbon Fiber-Reinforced Polymer Reinforcing
<b>03 30 00</b>	<b>Cast-in-Place Concrete</b>
03 30 53	Miscellaneous Cast-in-Place Concrete
<b>03 31 00</b>	<b>Structural Concrete</b>
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

Project: Southside Middle School  
 Estimator: Sally Jackson  
 Date: June 18, 2003

### Estimate Summary

CSI Division	Description	Labor	Material	Suppliers & Subcontractors	Total
1	Jobsite General Conditions	\$130,000	\$42,200	\$5,800	\$178,000
2	Sitework	\$13,300	\$26,600	\$345,000	\$384,900
3	Concrete	\$99,800	\$134,100	\$58,000	\$291,900
4	Masonry	\$0	\$0	\$37,000	\$37,000
5	Structural Steel	\$50,000	\$0	\$150,000	\$200,000
6	Carpentry	\$10,000	\$7,800	\$26,700	\$44,500
7	Roofing and Insulation	\$2,500	\$4,300	\$125,400	\$132,200
8	Doors and Glazing	\$2,500	\$1,500	\$139,600	\$143,600
9	Finishes	\$0	\$0	\$306,000	\$306,000
10	Specialties	\$3,500	\$2,255	\$21,000	\$26,755
11	Audio-Visual Equipment	\$0	\$0	\$25,000	\$25,000
12	Furnishings	\$3,750	\$2,575	\$56,000	\$62,325
13	Special Construction	\$0	\$0	\$0	\$0
14	Elevators	\$0	\$0	\$30,000	\$30,000
15	Mechanical				
	Plumbing	\$0	\$0	\$66,200	\$66,200
	HVAC	\$0	\$0	\$155,200	\$155,200
	Fire Protection	\$0	\$0	\$56,800	\$56,800
16	Electrical	\$0	\$0	\$205,600	\$205,600
	Subtotal	<u>\$315,350</u>	<u>\$221,330</u>	<u>\$1,809,300</u>	<u>\$2,345,980</u>
	Labor Burdens	45% of labor		\$141,908	\$2,487,888
	Liability Insurance		1%	\$24,879	\$2,512,767
	Builders Risk Insurance		0.20%	\$5,026	\$2,517,793
	State Excise Tax		1%	\$25,178	\$2,542,971
	Home Office Overhead and Profit		5%	\$127,148	\$2,670,119
	<b>Total Estimate:</b>				<u><b>\$2,670,119</b></u>

# Quantity Take Off

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- Break a project down into work packages (e.g., excavate for spread footings, place concrete for spread footings)
  - This can be really hard!
- Determine quantity for work package
  - Requires a strong understanding of the work involved
  - Be careful with details, scales, and units
  - Take advantage of repeated project elements
  - Make sure you don't quantify the same element twice
  - Account for waste, shrinkage, swell, equipment wear

# Unit Pricing

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- Sources of pricing information
  - Publications
  - In-house data
  - Material suppliers
  - Equipment rental companies
  - Subcontractors
  - Unions
  - Government offices
  - Insurance and bonding providers



# Unit Pricing (Cont'd)

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- **Material Costs:**

- Specifications (e.g.: model number, color, finish)
- Price valid until delivery time
- Delivery
- Warranties and guarantees
- Lead time to delivery
- Supplier's stock
- Supplier's reputation
- Payment terms *Important to control to prevent negative cash flow!*

# Unit Pricing (Cont'd)

*\*Total Fringe: Health + Pension + Apprentice  
FICA: Federal Insurance Contributions Act*

- **Labor Costs:**

- Wage rate

- Trade
    - Union vs. Non-Union
    - Project location
    - Fringe

- Productivity

- Crew efficiency
    - Concurrent work
    - Weather conditions
    - Workspace
    - Regular vs. overtime

Washington State Carpenters (sample)	Journeyman	
	Regular Time	Time & a Half
Rate	\$27.95	\$41.93
Health	2.90	2.90
Pension	3.87	3.87
Apprentice	<u>0.35</u>	<u>0.35</u>
Total Fringe	<u>7.12</u>	<u>7.12</u>
Taxable Wage Rate	35.07	49.05
FICA @ 7.65%	2.14	3.21
State Unem. @ 5.42%	1.51	2.27
Fed. Unem. @ 0.8%	0.22	0.34
Workers Comp @ \$2.0859/hr	<u>2.09</u>	<u>2.09</u>
Total Payroll Taxes & Insurance	<u>5.96</u>	<u>7.91</u>
Labor Burden (fringe + tax & ins)	13.08	15.03
<b>Total Labor Rate</b>	<b>41.03</b>	<b>56.96</b>

# Unit Pricing (Cont'd)

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- **Equipment Costs**
  - Cost of ownership, lease, or rental
    - Interest
    - Storage
    - Insurance
    - License
    - Taxes
  - Operation
    - Gasoline/oil
    - Maintenance
    - Transportation
    - Mobilization
    - Operator (may be included with labor)
- **Item-by-item basis vs. project basis**

# Overhead and Profit

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- Job organization
- Travel expenses
- Engineering support
- Marketing, legal, and accounting fees
- Testing
- Equipment (project basis)
- Field office
- Temporary utilities
- Permits
- Temporary roads
- Insurance and bonds
- Clean up
- Safety devices/signs/barricades
- Photographs
- Taxes (other than direct costs)

# In Class Exercise

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- **In Austin:**

1. Find the estimated cost of putting in place 500 lf of 10' high large columns
2. Find the estimated installation cost of 10 25'x25' waffle slab bays with a 75 psf load
3. Find the cost of elevated floors on a 5 story (5 stories with 4 elevated floors and a roof) apartment block with 10,000sf/floor. Slab on grade construction.

# In Class Exercise

---

1. Find the estimated **total cost of precast concrete** **500 lf** (linear foot = regular feet) **of 12' high large columns**

# Example

03400   Precast Concrete												
03410   Plant Precast				CREW	DAILY OUTPUT	LABOR HOURS	UNIT	2000 BARE COSTS				TOTAL INCL O&P
								MAT.	LABOR	EQUIP.	TOTAL	
100	0011	BEAMS, "L" shaped, 20' span, 12" x 20"	R03410-030	C-11	32	2.250	Ea.	1,350	69.50	49	1,468.50	1,675
	1000	Inverted tee beams, add to above, small beams					L.F.	15%				
	1050	Large beams				"	5.55			5.55	6.10	
	1200	Rectangular, 20' span, 12" x 20"	C-11	32	2.250	Ea.	925	69.50	49	1,043.50	1,200	
	1250	18" x 36"		24	3		1,700	93	65	1,858	2,100	
	1300	24" x 44"		22	3.273		2,450	101	71	2,622	2,950	
	1400	30' span, 12" x 36"		24	3		2,175	93	65	2,333	2,600	
	1450	18" x 44"		20	3.600		3,050	111	78	3,239	3,625	
	1500	24" x 52"		16	4.500		4,325	139	97.50	4,561.50	5,100	
	1600	40' span, 12" x 52"		20	3.600		4,025	111	78	4,214	4,700	
	1650	18" x 52"		16	4.500		4,900	139	97.50	5,136.50	5,750	
	1700	24" x 52"		12	6		6,000	186	130	6,316	7,075	
	2000	"T" shaped, 20' span, 12" x 20"		32	2.250		1,600	69.50	49	1,718.50	1,950	
	2050	18" x 36"		24	3		2,550	93	65	2,708	3,050	
	2100	24" x 44"		22	3.273		3,600	101	71	3,772	4,200	
	2200	30' span, 12" x 36"		24	3		3,650	93	65	3,808	4,225	
	2250	18" x 44"		20	3.600		4,975	111	78	5,164	5,750	
	2300	24" x 52"		16	4.500		5,150	139	97.50	5,386.50	6,000	
	2500	40' span, 12" x 52"		20	3.600		6,850	111	78	7,039	7,825	
	2550	18" x 52"		16	4.500		7,500	139	97.50	7,736.50	8,600	
2600	24" x 52"		12	6		9,150	186	130	9,466	10,600		
210	0010	COLUMNS Rectangular to 12' high, small columns		C-11	120	.600	L.F.	66.50	18.55	13.05	98.10	120
	0050	Large columns			96	.750		105	23	16.30	144.30	175
	0300	24' high, small columns			192	.375		99	11.60	8.15	118.75	138
	0350	Large columns			144	.500		132	15.45	10.85	158.30	184

# Example

16	WEIGHTED AVERAGE	95.6	54.6	75.7	97.0	38.4	68.6	98.8	50.3	75.3	98.0	59.8	79.5	94.9	64.5	80.2	97.3	39.7	69.4		
DIVISION		TENNESSEE						TEXAS													
		MEMPHIS			NASHVILLE			ABILENE			AMARILLO			AUSTIN			BEAUMONT				
		375,380 - 381			370 - 372			795 - 796			790 - 791			786 - 787			776 - 777				
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL		
	SITE CONSTRUCTION	100.6	92.5	94.4	96.1	100.7	99.7	103.1	84.4	88.8	103.2	85.5	89.6	90.3	86.5	87.4	98.5	82.8	86.4		
1	CONCRETE FORMS & ACCESSORIES	96.3	61.3	66.2	96.0	68.6	72.4	96.6	54.3	60.3	100.3	60.8	66.4	99.0	65.5	70.2	106.0	71.6	76.5		
1	CONCRETE REINFORCEMENT	93.6	61.0	75.1	93.4	61.7	75.4	95.7	63.3	77.3	95.7	56.9	73.7	93.6	64.9	77.3	93.8	59.3	74.2		
1	CAST-IN-PLACE CONCRETE	97.4	67.7	85.0	91.0	66.7	80.9	99.1	50.9	79.0	102.8	60.2	85.0	89.2	62.5	78.1	92.8	68.5	82.7		
	CONCRETE	90.8	65.4	78.0	87.7	68.3	77.9	90.7	55.8	73.1	92.7	60.6	76.6	81.2	64.9	73.0	88.7	68.6	78.6		
	MASONRY	82.5	64.3	71.2	84.6	62.6	70.9	99.8	54.4	71.5	103.5	52.6	71.8	100.0	59.3	74.7	103.0	71.3	83.2		
	METALS	97.2	93.0	95.7	99.8	91.2	96.7	96.8	73.7	88.5	96.8	70.9	87.5	96.9	74.3	88.8	97.1	73.2	88.5		
	WOOD & PLASTICS	94.6	62.4	77.9	91.2	70.9	80.7	96.4	55.6	75.3	99.7	63.3	80.9	97.1	68.4	82.3	107.2	74.2	90.1		
	THERMAL & MOISTURE PROTECTION	99.9	66.0	84.0	97.2	64.8	82.0	96.6	60.1	79.5	98.7	55.6	78.5	94.9	64.3	80.6	96.6	71.0	84.6		
	DOORS & WINDOWS	99.8	66.1	91.6	93.8	69.3	87.8	93.6	58.4	85.0	93.6	58.0	84.9	96.2	67.6	89.2	98.1	67.5	90.7		
	PLASTER & GYPSUM BOARD	101.2	61.5	76.6	100.1	70.5	81.8	94.8	55.1	70.2	94.8	63.2	75.2	95.9	68.3	78.8	96.9	74.4	83.0		
	CEILINGS	90.4	61.5	71.4	91.8	70.5	77.8	102.5	55.1	71.4	102.5	63.2	76.7	90.3	68.3	75.8	106.9	74.4	85.6		
	FLOORING	93.4	55.5	84.2	99.5	68.1	91.8	118.9	60.7	104.7	118.7	54.3	103.0	98.7	62.4	89.8	118.3	78.1	108.5		
	PAINTS & COATINGS	98.0	67.0	79.9	107.3	62.2	81.0	94.7	70.7	80.7	94.7	50.5	68.9	99.3	56.7	74.4	90.5	68.1	77.4		
	FINISHES	94.9	60.4	77.3	101.7	68.1	84.6	102.6	57.1	79.4	102.6	58.6	80.2	94.1	64.1	78.8	99.0	72.8	85.6		
4	TOTAL DIV. 10000 - 14000	100.0	73.2	94.3	100.0	73.3	94.4	100.0	70.9	93.8	100.0	64.3	92.4	100.0	67.7	93.2	100.0	75.7	94.9		
	MECHANICAL	100.0	66.2	84.7	100.0	65.1	84.2	100.0	46.7	75.9	100.0	56.3	80.2	99.9	61.9	82.7	99.9	64.9	84.0		
	ELECTRICAL	98.6	77.5	84.2	100.8	59.5	72.6	97.6	49.4	64.8	98.5	59.9	72.2	97.4	67.5	77.0	94.5	75.0	81.2		
3	WEIGHTED AVERAGE	96.8	72.3	84.9	96.9	71.0	84.4	97.7	58.1	78.5	98.3	62.0	80.7	95.5	67.3	81.9	97.5	71.8	85.1		



# In Class Exercise

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1. Find the estimated total cost of precast concrete 500 lf (linear foot = regular feet) of 12' high large columns
  - 12' high large columns = \$175/lf
  - Austin city cost index = 73 (concrete)
  - Total estimated cost =  $\$175/\text{lf} \times 500 \text{ lf} \times 0.73 = \underline{\underline{\$63,875}}$

# In Class Exercise

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2. Find the estimated installation cost of 10 25'x25' cast in place waffle slab bays with a 75 psf load

# Example

B1010 227		Cast in Place Waffle Slab						
	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	MINIMUM COL. SIZE (IN.)	RIB DEPTH (IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F.		
						MAT.	INST.	TOTAL
3900	20 x 20	40	12	8	144	6.20	8.15	14.35
4000	RB1010 -010	75	12	8	179	6.30	8.25	14.55
4100		125	16	8	229	6.40	8.35	14.75
4200		200	18	8	304	6.65	8.60	15.25
4400	20 x 25	40	12	8	146	6.30	8.20	14.50
4500	RB1010 -100	75	14	8	181	6.45	8.30	14.75
4600		125	16	8	231	6.55	8.40	14.95
4700		200	18	8	306	6.75	8.65	15.40
4900	25 x 25	40	12	10	150	6.45	8.25	14.70
5000		75	16	10	185	6.60	8.45	15.05
5300		125	18	10	235	6.75	8.60	15.35
5500		200	20	10	310	6.90	8.75	15.65
5700	25 x 30	40	14	10	154	6.60	8.30	14.90
5800		75	16	10	189	6.70	8.45	15.15
5900		125	18	10	239	6.85	8.60	15.45
6000		200	20	12	329	7.45	9.05	16.50
6400	30 x 30	40	14	12	169	7	8.55	15.55
6500		75	18	12	204	7.10	8.65	15.75
6600		125	20	12	254	7.20	8.75	15.95
6700		200	24	12	329	7.70	9.20	16.90

# Example

16	WEIGHTED AVERAGE	95.6	54.6	75.7	97.0	38.4	68.6	98.8	50.3	75.3	98.0	59.8	79.5	94.9	64.5	80.2	97.3	39.7	69.4		
DIVISION		TENNESSEE						TEXAS													
		MEMPHIS			NASHVILLE			ABILENE			AMARILLO			AUSTIN			BEAUMONT				
		375,380 - 381			370 - 372			795 - 796			790 - 791			786 - 787			776 - 777				
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL		
	SITE CONSTRUCTION	100.6	92.5	94.4	96.1	100.7	99.7	103.1	84.4	88.8	103.2	85.5	89.6	90.3	86.5	87.4	98.5	82.8	86.4		
1	CONCRETE FORMS & ACCESSORIES	96.3	61.3	66.2	96.0	68.6	72.4	96.6	54.3	60.3	100.3	60.8	66.4	99.0	65.5	70.2	106.0	71.6	76.5		
1	CONCRETE REINFORCEMENT	93.6	61.0	75.1	93.4	61.7	75.4	95.7	63.3	77.3	95.7	56.9	73.7	93.6	64.9	77.3	93.8	59.3	74.2		
1	CAST-IN-PLACE CONCRETE	97.4	67.7	85.0	91.0	66.7	80.9	99.1	50.9	79.0	102.8	60.2	85.0	89.2	62.5	78.1	92.8	68.5	82.7		
	CONCRETE	90.8	65.4	78.0	87.7	68.3	77.9	90.7	55.8	73.1	92.7	60.6	76.6	81.2	64.9	73.0	88.7	68.6	78.6		
	MASONRY	82.5	64.3	71.2	84.6	62.6	70.9	99.8	54.4	71.5	103.5	52.6	71.8	100.0	59.3	74.7	103.0	71.3	83.2		
	METALS	97.2	93.0	95.7	99.8	91.2	96.7	96.8	73.7	88.5	96.8	70.9	87.5	96.9	74.3	88.8	97.1	73.2	88.5		
	WOOD & PLASTICS	94.6	62.4	77.9	91.2	70.9	80.7	96.4	55.6	75.3	99.7	63.3	80.9	97.1	68.4	82.3	107.2	74.2	90.1		
	THERMAL & MOISTURE PROTECTION	99.9	66.0	84.0	97.2	64.8	82.0	96.6	60.1	79.5	98.7	55.6	78.5	94.9	64.3	80.6	96.6	71.0	84.6		
	DOORS & WINDOWS	99.8	66.1	91.6	93.8	69.3	87.8	93.6	58.4	85.0	93.6	58.0	84.9	96.2	67.6	89.2	98.1	67.5	90.7		
	PLASTER & GYPSUM BOARD	101.2	61.5	76.6	100.1	70.5	81.8	94.8	55.1	70.2	94.8	63.2	75.2	95.9	68.3	78.8	96.9	74.4	83.0		
	CEILINGS	90.4	61.5	71.4	91.8	70.5	77.8	102.5	55.1	71.4	102.5	63.2	76.7	90.3	68.3	75.8	106.9	74.4	85.6		
	FLOORING	93.4	55.5	84.2	99.5	68.1	91.8	118.9	60.7	104.7	118.7	54.3	103.0	98.7	62.4	89.8	118.3	78.1	108.5		
	PAINTS & COATINGS	98.0	67.0	79.9	107.3	62.2	81.0	94.7	70.7	80.7	94.7	50.5	68.9	99.3	56.7	74.4	90.5	68.1	77.4		
	FINISHES	94.9	60.4	77.3	101.7	68.1	84.6	102.6	57.1	79.4	102.6	58.6	80.2	94.1	64.1	78.8	99.0	72.8	85.6		
4	TOTAL DIV. 10000 - 14000	100.0	73.2	94.3	100.0	73.3	94.4	100.0	70.9	93.8	100.0	64.3	92.4	100.0	67.7	93.2	100.0	75.7	94.9		
	MECHANICAL	100.0	66.2	84.7	100.0	65.1	84.2	100.0	46.7	75.9	100.0	56.3	80.2	99.9	61.9	82.7	99.9	64.9	84.0		
	ELECTRICAL	98.6	77.5	84.2	100.8	59.5	72.6	97.6	49.4	64.8	98.5	59.9	72.2	97.4	67.5	77.0	94.5	75.0	81.2		
3	WEIGHTED AVERAGE	96.8	72.3	84.9	96.9	71.0	84.4	97.7	58.1	78.5	98.3	62.0	80.7	95.5	67.3	81.9	97.5	71.8	85.1		

# In Class Exercise

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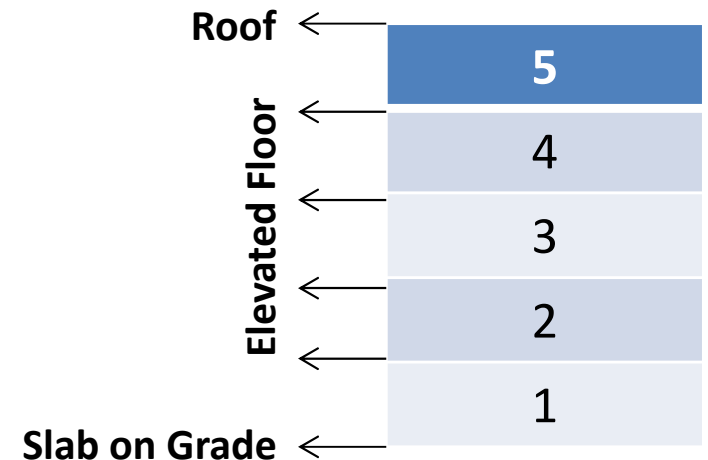
2. Find the estimated installation cost of 10 25'x25' cast in place waffle slab bays with a 75 psf load

- 25'x25' waffle slab, 75 psf load = \$8.45/sf (installation)
- Austin city cost index = 64.9 (concrete installation)
- Total estimated cost =  $\$8.45/\text{sf} \times 10 \times 0.649 \times (25' \times 25')$   
 $= \underline{\underline{\$34,275}}$

# In Class Exercise

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3. Find the cost of **elevated floors** on a **5 story** (5 stories with 4 elevated floors and a roof) **apartment** block with 10K sf·floor. Slab on grade construction.



# Example

Model costs calculated for a 6 story building  
with 10'-4" story height and 60,000 square feet  
of floor area

## Apartment, 4-7 Story

			Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
<b>1.0 Foundations</b>						
.1	Footings & Foundations	Poured concrete; strip and spread footings and 4' foundation wall	S.F. Ground	7.20	1.20	1.8%
.4	Piles & Caissons	N/A	—	—	—	
.9	Excavation & Backfill	Site preparation for slab and trench for foundation wall and footing	S.F. Ground	1.02	.17	
<b>2.0 Substructure</b>						
.1	Slab on Grade	4" reinforced concrete with vapor barrier and granular base	S.F. Slab	3.32	.55	0.7%
.2	Special Substructures	N/A	—	—	—	
<b>3.0 Superstructure</b>						
.1	Columns & Beams	Gypsum board fireproofing on columns, steel columns in 3.5 and 3.7	S.F. Floor	1.61	1.61	18.1%
.4	Structural Walls	N/A	—	—	—	
.5	Elevated Floors	Open web steel joists, slab form, concrete, steel columns	S.F. Floor	12.49	10.41	
.7	Roof	Open web steel joists with rib metal deck, steel columns	S.F. Roof	3.06	.85	
.9	Stairs	Concrete filled metal pan	Flight	4070	1.09	
<b>4.0 Exterior Closure</b>						
.1	Walls	Face brick with concrete block backup	S.F. Wall	15.30	6.80	10.9%
.5	Exterior Wall Finishes	N/A	—	—	—	
.6	Doors	Aluminum and glass	Each	2637	.18	
.7	Windows & Glazed Walls	Aluminum horizontal sliding	Each	304	1.42	
<b>5.0 Roofing</b>						
.1	Roof Coverings	Built-up tar and gravel with flashing	S.F. Roof	2.70	.45	0.9%
.7	Insulation	Perlite/EPS composite	S.F. Roof	1.32	.22	
.8	Openings & Specialties	N/A	—	—	—	
<b>6.0 Interior Construction</b>						
.1	Partitions	Gypsum board and sound deadening board on metal studs	S.F. Partition	3.62	3.62	26.1%
.4	Interior Doors	15% solid core wood, 85% hollow core wood	Each	467	5.84	
.5	Wall Finishes	70% paint, 25% vinyl wall covering, 5% ceramic tile	S.F. Surface	1.13	2.26	
.6	Floor Finishes	60% carpet, 30% vinyl composition tile, 10% ceramic tile	S.F. Floor	4.42	4.42	
.7	Ceiling Finishes	Painted gypsum board on resilient channels	S.F. Ceiling	2.80	2.80	
.9	Interior Surface/Exterior Wall	Painted gypsum board on furring	S.F. Wall	3.02	1.21	
		8 S.F. Floor/L.F. Partitions				
		80 S.F. Floor/Door				
		80% of wall				

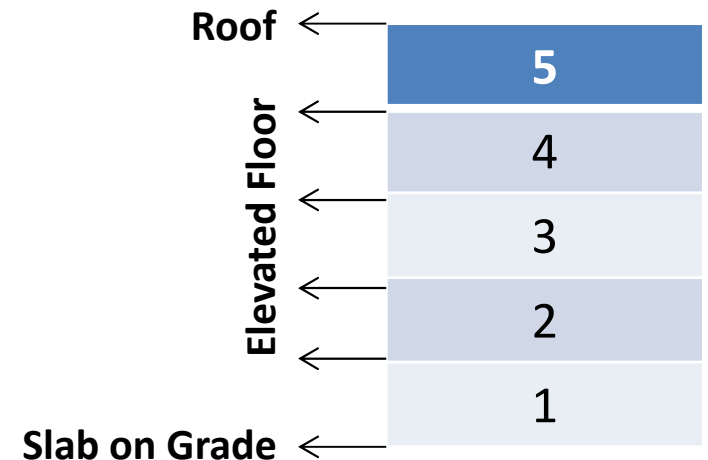


# In Class Exercise

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3. Find the cost of elevated floors on a 5 story (5 stories with 4 elevated floors and a roof) apartment block with 10K sf·floor. Slab on grade construction.

- 5 story, elevated floors = \$12.49/unit
- Austin city cost index = 73 (concrete)
- Total estimated cost =  $\$12.49/\text{unit} \times 10,000 \times 0.73 \times 4$   
 $= \underline{\underline{\$364,708}}$





# Bid Estimate

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- **Standard Estimating**

- Provide material quantity, labor hour information for given construction activities in standard construction environment
- Yearly updated by 50 review committees

Civil 6-1-2 Mortar

(m<sup>3</sup>당)

Mixing Ratio	Cement	Sand	Labor
1 : 1	1,093	0.78	1.0
1 : 3	510	1.10	1.0
1 : 5	320	1.15	0.9