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COMPASS INTERNATIONAL INC.

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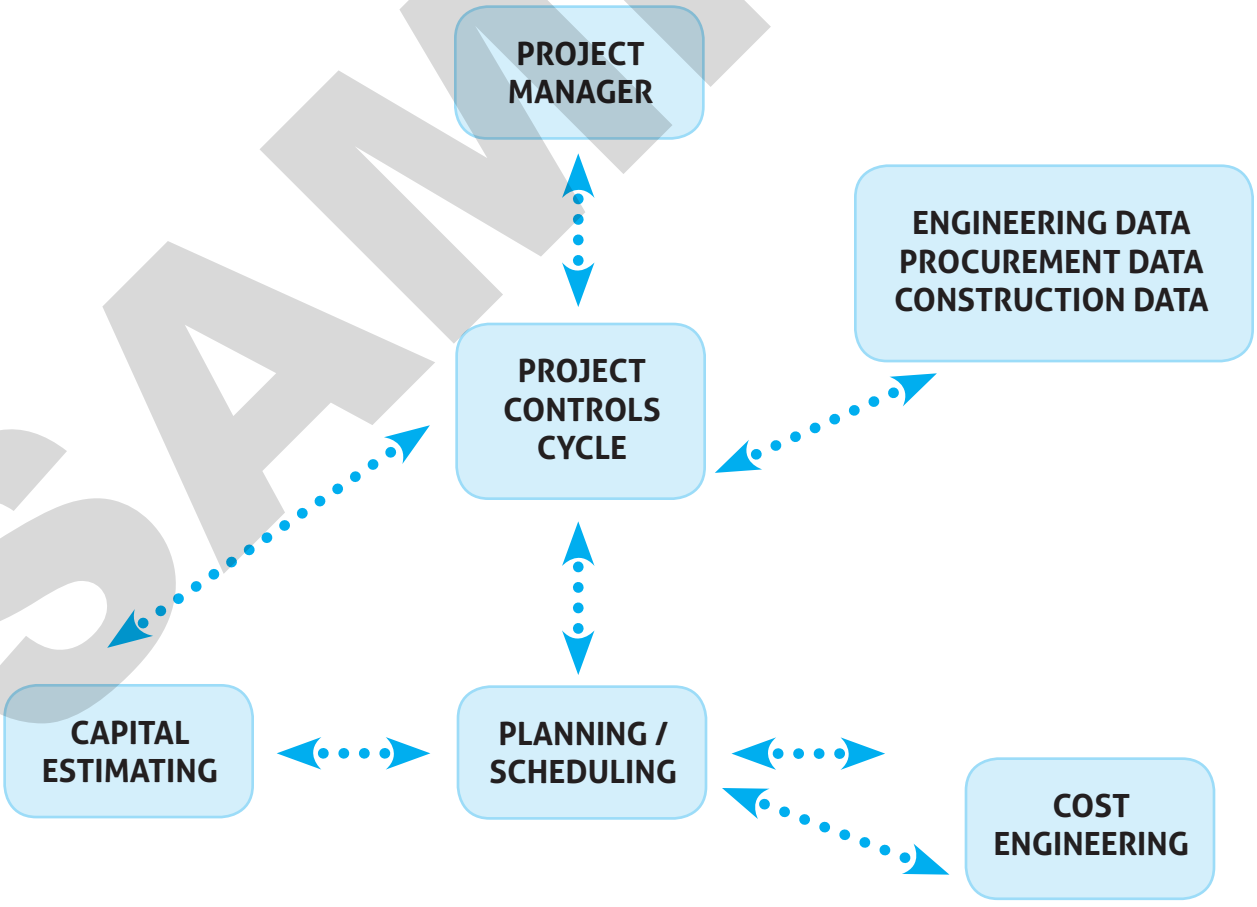
existing facility to accommodate this new product? Should the capital cost estimate include land purchase? Is any demolition or site remediation costs to be evaluated? Are there differing manufacturing process (steps) that can be used? Are there cost differences in the operating costs of these processes? Will the new facility be given grants, tax holidays and or incentives by the state or country that the new facility will be located? Will this facility (new or add on) require new services and utilities? Will we need to train / educate the plant operators? Will the new plant require state of the art control systems, or can we obtain a competitive advantage by using low cost labor to operate the plant and minimize costs on the I/C account? Lots of questions need to be tabled and answered during the CAPEX estimating effort. These questions and many more will have to be analyzed in some detail prior to proceeding with the prospective CAPEX project.

In the early phases of the project, the Front End / Conceptual Cost Estimate should provide a framework to measure trends and to determine key project milestones.

The number one indispensable principle of Project Control – Cost Estimating is to deliver the best technical and business solution to the business unit considering or bidding on a new facility expansion(s) or upgrade(s), together with value (which of course is part of the business solution) for future CAPEX investments. The project team must deliver the correct business solution at the front end stage(s) of CAPEX project. The scope, needs to be to some extent defined, some front end design work (basic design) needs to have been completed, various manufacturing / production schemes need to have been considered and scoped out to determine their viability. The decision to engineer / procure and construct (EPC) a new Chemical / Manufactur-



ing Facility, or to upgrade, revamp or modernize an existing facility is many times based on future business growth, maintaining market share and to ultimately to increase profits and ROI. Chemical / Manufacturing Facilities must be designed to meet the goals of (1) Safety, (2) Quality of final product and (3) Profit – Return on Investment. The conceptual estimator / engineer is a person who can predict / analyze the "future" cost of an Engineering, Procurement and Construction (EPC) project(s) with a very modest (minimal) amount of "real" data regarding the details of the project (basically there are no detailed design deliverables at this stage – the future "CAPEX project" is in it's infancy, very much in the speculative or conceptual mode), typically these types of estimates are required at the very front end / early stages of a project, they are typically used to:

1. Evaluate the capital costs associated with a new or add on to a current facility. In addition they can be used to determine the viability of producing new products at a certain location. They can also be used to audit and initially checkout the proposal of an A/E firm or EPCM contracting company.
2. Used in the traditional annual or five year capital expansion / forecasting effort i.e. does the business outlook in Chile enable the project to produce an attractive ROI now or in the next two years.
3. Used as a tool to determine the best EPC approach to maximize the owner companies Return on Investment (ROI). They can also be used as the management "go / no go" decision tool.

The Project Control cycle - is the methodical review and analysis of the projects (Scope of Work) from a cost / schedule standpoint. The following flow chart demonstrates the coordination that is required to have "accurate" Project Control on a CAPEX Project.

Regular updates / communications to the Project Manager of any departures from the current cost estimate and schedule and counseling the Project Manager / Project Team on any potential (EPC) problems is the job of the Project Controls Group and possible solutions that will ensure the projects budget and schedule is maintained or optimized. This publication focuses on Capital Cost Estimating element of the above Project Control Cycle. The foremost purpose of the compilation of a capital cost estimate is to transform engineering / design, procurement and construction deliverables and data into an accurate prediction of current and or future construction cost(s).

Capital Cost Estimates (CAPEX) - what are they used for:

- A tool for analyzing various case studies / business economic models:
- An assessment of costs and resources to complete a specific scope of work:
- An appropriation for funds, appropriation for expenditure - (AFE):
- A basis for analysis of contractors and vendors bids and submissions.
- The supporting documents that are the basis of an offer / bid to complete a work / scope item:
- A basis for future cash flow requirements and forecasting.
- A project control tool: (used to monitor and control the EPC effort).
- A benchmark tool for determining future project costs and possible use as a historical data tool for future CAPEX estimating applications.

Issues and factors that can influence a capital cost estimate, this list together with other data within this publication should be used as a checklist to ensure that the cost estimating effort is completed and fully budgeted (i.e. scoped out): see following page for chart.

The following pages and sections A -1, A -2 and A -3 of this database will describe in some detail, the following types of capital cost estimates, a more complete description of these estimates and hybrids of these estimates are discussed in section A-3.

- Order of Magnitude Estimate (OOM). Typically arrived at by utilizing cost capacity curves, SF / M2 / M3 units, ratios, factors, exponents and historical percentages, for example barrels per day, $'s per MW, tons of production per year.

Issues and Factors

IMPACTING THE BOTTOM LINE OF A CAPEX ESTIMATE ENGINEERING

#	ISSUES AND FACTORS
1	Production of design deliverables / specifications (who produces Owner or EPC firm / when).
2	C / S / A design deliverables (who produces / when).
3	Process Flow Diagrams (who produces – Owner or EPC firm / when).
4	E/I design deliverables / Control Philosophy / Classification (does owner have a preferred vendor who produces outline spec / when).
5	Piping design and detailing (who produces – does this exist – has Owners Engineering group produced the first draft of this document / when).
6	Relevant codes to be utilized.
7	Other Engineering issues.
	PROCUREMENT
1	Long lead items (M.E. items) some complex items such as a multi-stage compressor could take as long as twelve months to design and produce.
2	Freight issues.
3	Import duties.
4	Bulk material purchasing.
5	Expediting.
6	Inspection / trafficking / performance testing.
7	Warehousing.
8	Early delivery bonuses / payments.
9	Other Procurement issues i.e. spare parts, vendor assistance.
	CONSTRUCTION
1	Location of facility (USA or Overseas).
2	Weather issues (cold or hot climate).
3	Productivity expectations of workforce.
4	Union / Non union / Merit Shop construction approach.
5	Plant start up activities.
6	Labor availability and possible overtime / shift work requirements.
7	Protection of the completed work.
8	General Conditions / Preliminaries.
9	Construction equipment usage.
10	Establish camp / Establish concrete batch plant.
11	All required permits.
12	Small tools / Consumables.
13	Guards / Security.
14	Special safety issues.
15	Cleaning protocols / special requirements.
	PROJECT SPECIFIC ITEMS
1	Completion date (Normal schedule or fast track schedule).
2	Escalation / Taxes.
3	Operator Training issues.
4	Owner costs / Owner provided items.
5	Contractual issues / Type of contract.
6	Warranty issues (procure extended warranty period).
7	Payment terms / Financing costs.
8	Currency impact issues.
9	Insurance issues (BAR / Umbrella / Bonds).
10	Liquidated damages / Consequential damages clauses.
11	Bonus / Penalty clause for early or delayed completion.
12	Contingency issues (technical and general contingency).

• A Preliminary Estimate / Funding Estimate. Typically prepared when the conceptual / detailed design is 20% - 50% complete (or when the detailed design is perhaps 5% - 25% complete, or even less) Many times based on early PFD's early P&ID's, preliminary plot plans – indicating where major equipment is located – many times the operation(s) group has not bought into these early concepts and they have a habit of moving around, however there is some realism usually associated with these concepts.

• A Definitive Estimate / Control Estimate / Validation Estimate with the detailed design effort perhaps 30% - 50% complete, more information is known, bids / quotes have been obtained for some of the key major equipment, initial quantity take-off's are available for civil, piping, electrical and instrumentation, the scope of the engineering effort is pretty well known.

• A Lump Sum Bid – Hard Money / GMP Estimate. A lot is now known about the project, the scope of work is reasonably "nailed down" the detailed design is typically 70% - 100% complete, bulk materials and major equipment (long lead items) are on order, or some of the construction work is under way i.e. site work, piling and foundations may be partially installed.

The following table will give the reader an appreciation of were the "big cost drivers" are in a typical chemical facility project, not surprisingly these values will not be the same for each specific facility, however these values can be used as a benchmark or guide, the percentages are based on numerous (30+) projects that have been executed in the last ten years, they are a mix of new and revamped CAPEX projects with perhaps 70% of the data coming from "new" $5 - $45 million chemical and manufacturing facilities.

Typical Cost Breakdown of a new Chemical / Process related Facility (constructed on an existing facility with available utilities – that may need some upgrading):

Note: These values are appropriate to Inside Battery Limits (ISBL work) – Outside Battery Limits (OSBL scope / work) is not included in above values. Contingency is included in above values (it has been pro-rated into the above percentages). The activity of capital cost estimating is at best a time-consuming and an easier said than done undertaking. Trying to forecast the many project variables such as weather, productivity, labor costs, major equipment, field in directs, bulk material quantities and

Typical Cost Breakdown

NEW CHEMICAL / PROCESS RELATED FACILITY

CATEGORY	PERCENTAGE VALUE	PERCENTAGE RANGE
Major Equipment (includes freight) the value for freight is 3%. For overseas applications requiring ocean freight. This number could increase. Ocean freight typically is 7% - 10% of the M.E. value.	22.9	18 - 27
Materials (Bulks / Engineered).	21.5	17 -26
Labor costs – including sub-contractors.	24.3	19 - 29
Field In-directs / General Conditions / Preliminaries.	11.7	9 - 13
Detailed Design / H O support / Procurement / PM (includes Owner Engineering) Includes all necessary design deliverables.	13.9	10 - 17
Construction Management (incl CM Gen Conditions)	5.7	4 - 8
TOTAL	**100.0**	**100.0**

unit costs, taxes and escalation and to attempt to look into the future, say two or three years, is very difficult and demanding, encumbered with potential dangers (future events are of course difficult to anticipate, for example, who would have thought in the early 2000's that a barrel of oil would cost $140 + a barrel in January of 2009 and then drop like a stone to $35), hopefully this publication will shed some light on these important topic(s).

A CAPEX capital cost estimate can be considered as one of the following:

- The bottom line cost / bid for completing an Engineering, Procurement and Construction effort, it is the work effort of determining all the numerous cost elements which will be required for a particular activity / (EPC) construction project and arriving at a total cost value for completing the itemized scope of work (basically a shopping list of required items).
- A cost summary together with a description of work (scope of work / mission statement) specific to a project to be performed or considered.
- A current photograph / snapshot of an (EPC) project(s) current scope of work together with a cost value of its anticipated final cost.
- A judgment / opinion of final cost by a person(s) / cost engineer(s) / cost estimator(s) / project team that has considered the SOW to be performed.

This data source and the basic focus of this publication is targeted primarily at the manufacturing / process industry / chemical engineering / pharmaceutical / industrial sectors. 60% to 70% of the "cost estimating / benchmarking data" contained in this data source is targeted on these specific industry sectors, however it is not the aim of the database to exclude other construction industry sectors. Some of the following benchmarks and data can be use in estimating the cost of General Buildings (airports, logistic centers / warehouses, office facilities, public buildings, schools, together with civil engineering related projects etc.). Some of this data is outlined / indicated in section B 3, B 4 and C 1, this data can be used in the production of cost estimates for other "specific / one off" engineering and construction discipline items such as demolition, civil, site work, architectural, engineering and construction management fees, mechanical, electrical and instrumentation / controls and insulation (refer to section A 4 and D 1 for examples of these topics) which may be required and budgeted using similar / parallel conceptual / front end estimating methods and procedures described in this data source. This should allow a cost estimator the ability to compile a reasonably accurate front – end CAPEX estimate. The main goal of this publication is to assist the user in not "dropping the ball" and making erroneous front end / conceptual type capital estimates and basically to provide a more focused and disciplined approach in producing a more accurate and concise front end / conceptual estimate(s) – i.e. to shed some light on an area of cost estimating that can be a challenge to new young estimators that are starting out in this business and need an initial road map to get started. The responsibilities, mission statement and basic activities of capital cost estimating (the "job") is for all intents and purposes a data gathering activity (getting your arms around the projects scope and documenting it), it includes reviewing design documents (design deliverables – drawings and specifications and scopes of work) if they exist and the preparing a take-off / shopping list of scope items that need to be completed in the execution of the CAPEX project. In addition it includes gathering local construction cost data, local material costs, field crew productivity / production statistics, deter-

The main goal of this publication is to assist the user in not "dropping the ball" and making erroneous front end / conceptual type capital estimates and basically to provide a more focused and disciplined approach in producing a more accurate and concise front end / conceptual estimate(s)

(2) Average Historical (Multiplier) Factors - Liquid Plants +/- 25% Accuracy (Chemicals / Fluids / Wet Process's type facilities, high percentage of pumps / piping) Assume Major Equipment cost is $1.00 million delivered to site the following average percentages should be used as a starting point. Off sites (O.S.B.L.) are excluded from the following data values.

Table 2
AVERAGE HISTORICAL (MULTIPLIER) FACTORS – LIQUID PLANTS

REF	DIRECT CONSTRUCTION COSTS	TYPICAL % OF M.E.	% BULK MATERIALS	% LABOR - S/C	TOTAL	REMARKS
1	Major Equipment (M.E.)	0	1.00*	0.00	1.00	Assume $1.00 million
2	Freight (used 4%)	2.5 - 5	0.02	0.02	0.04	50/50 split
3	Overseas Freight	5 - 8	N/A	N/A		N/A for this example
4	M.E. Setting (Millwright work)	1 - 7	0.01	0.05	0.06	Heavy lift cranes in line 15
5	Site work / civil (excavation / roads)	3 - 10	0.02	0.03	0.05	Site clearance / minor demolition
6	Concrete work	8 - 25	0.03	0.10	0.13	SOG & elevated
7	Structural steel	15 - 35	0.10	0.11	0.21	Including platforms
8	Facilities / Buildings (including services)	3 - 15	0.03	0.02	0.05	
9	Piping** (includes hangars & testing)	50 - 150	0.40	0.60	1.00	ISBL only
10	Electrical	15 - 45	0.09	0.13	0.22	Including tracing
11	Instrumentation / Controls	20 - 65	0.15	0.13	0.28	
12	Insulation	3 - 25	0.02	0.03	0.05	
13	Painting	2 - 10	0.01	0.01	0.02	
14	Safety / F P / Misc. (A)	4 - 12	0.02	0.03	0.05	
	TOTAL DIRECT COST	**1.90**	**1.26**	**3.16**		
	INDIRECT PROJECT COSTS					
15	Field Establishment Costs ***				0.29	23% of labor / S.C. costs
16	EPC Office H.O. range 20% - 30%				0.86	27% of total direct costs
17	Construction Management range 20% -.45% of line 16				0.21	25% of EPC H.O
18	Owner Engineering & CM 5% – 15% of line 16 & 17				0.11	10% of line 16 & 17
19	**TOTAL INDIRECT COSTS**				**1.47**	
20	**TOTAL COST MULTIPLIER**				**4.63**	

(A) = Start up costs, initial chemicals, expense items and other minor items.

** 1.00 = Total value of Major Equipment / Assume 25 items (M.E.)*
*** 50% - 150% is based on using a 60 - 40 split of Carbon Steel and 304-316 SS, this value could in some situations exceed 150% in circumstances were exotic / expensive piping materials are utilized, i.e. Glass / Kynar / Teflon lined / Alloy 20 / Nickel, etc., or high percentage of 304 - 316 SS, etc. is used due to hazardous / highly corrosive chemical applications.*
**** Field establishment includes, construction equipment, field offices, field in directs, G.C.'s & S/C trailers, temporary warehouses, Division 1 (Preliminaries) etc. If the proposed project is a hybrid of a liquids and solids plant, use an average of both plants / facilities.*

To establish a budget value for O.S.B.L. add between 5% and 70% of the above compiled values, typically the O.S.B.L. value will fall in the 10% to 25% range.

For revamp / upgrade / modernization projects calibrate the above values by the following.

- Minor revamps multiply by 1.05 –1.15
- Average revamp projects multiply by 1.15 to 1.25
- Major revamps multiply by 1.25 to 1.75

(3) Average Historical (Multiplier) Factors - Solids Plants +/- 25% Accuracy (Cement / Powder(s) / Material Handling type facilities, typically low in piping). Assume Major Equipment cost is $1.00 million delivered to site the following average percentages should be used as a starting point. Off sites (O.S.B.L.) are excluded from the following data values.

To establish a budget value for O.S.B.L. add between 5% and 70% of the above compiled values,

Table 3
AVERAGE HISTORICAL (MULTIPLIER) FACTORS – SOLIDS PLANTS

REF	DIRECT CONSTRUCTION COSTS	TYPICAL % OF M.E.	% BULK MATERIALS	% LABOR - S/C	TOTAL	REMARKS
1	Major Equipment (M.E.)	0	1.00*	0.00	1.00	Assume $1.00 million
2	Freight (used 4%)	2.5 - 5	0.02	0.02	0.04	50/50 split
3	Overseas Freight	5 - 8	N/A	N/A		N/A for this example
4	M.E. Setting (Millwright work)	1 - 7	0.01	0.05	0.06	Heavy lift cranes in line 15
5	Site work / civil (excavation / roads)	3 - 10	0.03	0.04	0.07	Site clearance / minor demolition
6	Concrete work	10 - 50	0.04	0.12	0.16	SOG & elevated
7	Structural steel	20 - 50	0.13	0.15	0.28	Including platforms
8	Facilities / Buildings (including services)	3 - 20	0.03	0.02	0.05	
9	Piping** (includes hangars & testing)	25 - 100	0.25	0.40	0.65	ISBL only
10	Electrical	15 - 45	0.09	0.13	0.22	Including tracing
11	Instrumentation / Controls	15 - 60	0.13	0.12	0.25	
12	Insulation	3 - 25	0.02	0.03	0.05	
13	Painting	2 - 10	0.01	0.01	0.02	
14	Safety / F P / Misc. (A)	4 - 12	0.02	0.03	0.05	
	TOTAL DIRECT COST		**1.78**	**1.12**	**2.90**	
	INDIRECT PROJECT COSTS					
15	Field Establishment Costs ***				0.25	22% of labor / S.C. costs
16	EPC Office H.O. range 20% - 30%				0.67	23% of total direct costs
17	Construction Management range 20% -.45% of line 16				0.17	25% of EPC H.O
18	Owner Engineering & CM 5% – 15% of line 16 & 17				0.08	10% of line 16 & 17
19	**TOTAL INDIRECT COSTS**				**1.17**	
20	**TOTAL COST MULTIPLIER**				**4.07**	

(A) = Start up costs, initial chemicals, expense items and other minor items.
** 1.00 = Total value of Major Equipment / Assume 25 items (M.E.)*
*** 25% - 100% is based on using a 60 - 40 split of Carbon Steel and 304-316 SS. This value could in some situations exceed 100% in circumstances where exotic / expensive piping materials are utilized, i.e. Glass / Kynar / Teflon lined / Alloy 20 / Nickel, etc., or high percentage of 304 - 316 SS etc. is used due to hazardous / highly corrosive chemical applications.*
**** Field establishment includes, construction equipment, field offices, field in directs, G.C.'s & S/C trailers, temporary warehouses, Division 1 (Preliminaries) etc. If the proposed project is a hybrid of a liquids and solids plant, use an average of both plants / facilities.*

typically the O.S.B.L. value will fall in the 10% to 25% range.

For revamp / upgrade / modernization projects calibrate the above values by the following.

- Minor revamps multiply by 1.05 –1.15
- Average revamp projects multiply by 1.15 to 1.25
- Major revamps multiply by 1.25 to 1.75 and possibly more for extreme situations.

Above costs exclude land purchase, currency impact, front end (study) engineering, spare parts, vendor assistance and off-sites, percentages / multipliers include contingency funds because the above stated values are based on numerous ”historical” return cost data, where the contingency was expended / incorporated into the capital cost of the completed facility. Engineering, Procurement Activities and Construction Management costs are included in the indirect costs. EPC Office includes engineering and design, procurement, project management / control and required administration. Owner C.M. is not included in the EPC office percentage.

Note: the factors for piping, electrical and instrumentation work indicated in (2) and (3) above could be reduced by 20 – 40% (use 30%) if work is fabricated as modules / pre-assemblies / skid, structural steel values should be increased by 10 – 20 % if work is completed as modules / pre-assemblies / skid (use 15%).

(4) M.E. / Percentage Uplift Cost Model: The following historical data reflects a chemical process facilities (valued between $3 - $65 million): 8 liquid process and 4 liquid / solid process and 2 solid process, 3 minor revamp projects are included) constructed in North America in the 1990’s the costs have been calibrated to the mid point of 2006. M.E. / Process Equipment multipliers / benchmarks, data is based on average direct labor hourly rate $33.50, to establish union all in rate add 80 – 90%, for union application. For open shop all in rate add 40 – 75% uplift. Cost model is based on 76 # M.E. ISBL items costing $5,354,832, plus 32 # M.E. OSBL items costing $882,657.

Table 4

M.E. / PERCENTAGE UPLIFT COST MODEL – CHEMICAL PROCESS FACILITY

(A) DIRECT WORK - ISBL	MATERIAL	%	LABOR	%	TOTAL
Major Equipment (M.E.) 76 # items	5,354,832	0	0	0.00%	5,354,832
Freight	112,034	2.09%	0	0.00%	112,034
M.E. Setting in place	36,745	0.69%	392,564	7.33%	429,309
Site Work / Preparation	134,567	2.51%	102,456	1.91%	237,023
Civil / Concrete	210,665	3.93%	332,887	6.22%	543,552
Facilities / Architectural Finishes / Siding	187,097	3.49%	203,599	3.80%	390,696
Structural Steel / Miscellaneous platforms	654,942	12.23%	275,348	5.14%	930,290
Piping Systems	1,587,337	29.64%	1,824,484	34.07%	3,411,821
Electrical Systems	683,457	12.76%	588,244	10.99%	1,271,701
Instrument / Controls	1,315,337	24.56%	356,445	6.66%	1,671,782
Paint / Insulation / Refractory	198,605	3.71%	161,446	3.01%	360,051
Fire Protection / Safety	90,643	1.69%	91,022	1.70%	181,665
See note (1)	50,098	0.94%	65,644	1.23%	115,742
(A) TOTAL DIRECT MAT & LABOR	**10,616,359**	**98.26%**	**4,394,139**	**82.06%**	**15,010,499**

	MATERIAL	%	LABOR	%	TOTAL	
(B) INDIRECT WORK						
Trade Supervision / Foreman / Gangers etc.	87,698	1.64%	423,477	7.91%	511,175	
Consumable supplies	158,688	2.96%	19,769	0.37%	178,457	
Small Tools (items less than $200 per item)	182,486	3.41%	21,094	0.39%	203,580	
Site Establishment / Trailers / Temp Offices.	402,577	7.52%	163,974	3.06%	566,551	
Safety / Training	29,228	0.55%	63,779	1.19%	93,007	
Constr. Equipment costs. Rental / Owned.	63,773	1.19%	346,667	6.47%	410,440	
Constr. Equipment Repairs etc. / Fueling.	25,399	0.47%	68,621	1.28%	94,020	
Material Mgmt / Logistics / Field Support	197,099	3.68%	75,025	1.40%	272,124	
Testing Activities	19,987	0.37%	10,995	0.21%	30,982	
Site Clean Up	29,766	0.56%	71,987	1.34%	101,753	
Expense items (Demo / relocations)	17,564	0.33%	37,665	0.70%	55,229	
Sales Tax (optional cost item could be excluded)	297,974	5.56%	0	0.00%	297,974	
(B) TOTAL INDIRECT WORK MAT & LABOR	**1,512,239**	**28.24%**	**1,303,053**	**24.33%**	**2,815,292**	
TOTAL D & I (A+B) ISBL	**12,128,598**		**5,697,192**		**17,825,790**	
(C) DETAILED DESIGN - D.D.& S. / ISBL						
EPC Detailed Design					2,041,053	11.45% Of D&I
Construction Mgmt					650,641	3.65% Of D&I
Home Office support / field coordination					55,260	0.31% Of D&I
Travel Costs					276,300	1.55% Of D&I
Owner Project Eng / CM					62,390	0.35% Of D&I
Plant C.M. / Eng Support					128,346	0.72% Of D&I
Front End Project Eng					383,254	2.15% Of D&I
O/S Review / V.E. Study					96,259	0.54% Of D&I
Plant Gen Conditions					51,695	0.29% Of D&I
Consultants / Miscellaneous Costs					258,474	1.45% Of D&I
TOTAL (D.D.& S) ISBL					**4,003,672**	
TOTAL ISBL (A+B+C)					**21,829,462**	
(D) OFF SITES OSBL						
Major Equipment / Tank age 32 # items	882,657		0		882,657	
Freight	19,234	2.18%	0		19,234	
M.E. Setting in place	7,868	0.89%	38,960	4.41%	46,828	
Site Work / Preparation	27,564	3.12%	18,564	2.10%	46,128	
Civil / Concrete / Roads / Tank farm / Jetty Modifications	77,760	8.81%	134,564	15.25%	212,324	
Structural Steel / Miscellaneous platforms	27,860	3.16%	38,664	4.38%	66,524	

	MATERIAL	%	LABOR	%	TOTAL	
(D) OFF SITES OSBL (CONTINUED)						
Piping Systems	88,745	10.05%	93,664	10.61%	182,409	
Electrical Systems	40,453	4.58%	36,553	4.14%	77,006	
Instrument / Controls	58,894	6.67%	14,640	1.66%	73,534	
Paint / Insulation	18,547	2.10%	19,336	2.19%	37,883	
Fire Protection / Safety	15,453	1.75%	16,677	1.89%	32,130	
Loading Facilities	362,447	41.06%	79,774	9.04%	442,221	
(D) TOTAL DIRECT MAT & LABOR	**1,627,482**	**84.38%**	**491396**	**55.67%**	**2,118,878**	
(E) INDIRECT WORK						
Trade Supervision / Foreman / Gangers etc.	16,594	1.88%	66,641	7.55%	83,235	
Consumable supplies	29,392	3.33%	2,383	0.27%	31,776	
Small Tools (items less than $200 per item)	26,921	3.05%	2,207	0.25%	29,128	
Site Establishment / Trailers / Temp Offices.	48,899	5.54%	25,156	2.85%	74,055	
Safety / Training	3,089	0.35%	7,503	0.85%	10,592	
Constr. Equipment costs. Rental / Owned.	12,092	1.37%	65,758	7.45%	77,850	
Constr. Equipment Repairs etc. / Fueling.	4,855	0.55%	9,268	1.05%	14,123	
Material Mgmt / Logistics / Field Support	19,860	2.25%	10,592	1.20%	30,452	
Testing Activities	1,854	0.21%	1,324	0.15%	3,178	
Site Clean Up	3,707	0.42%	8,827	1.00%	12,534	
Expense items (Demo / relocations)	11,739	1.33%	14,387	1.63%	26,127	
Sales Tax (optional cost item could be excluded)	48,723	5.52%	0	0.00%	48,723	
TOTAL INDIRECT WORK	**227,726**		**214,044**		**441,770**	
TOTAL D & I (D+E) OSBL	**1,855,208**		**705,440**	**1**	**2,560,648**	
(F) DETAILED DESIGN D.D.& S. FOR OSBL						
EPC Detailed Design					136739	5.34% Of D&I
Construction Mgmt					82,197	3.21% Of D&I
Home Office support / field coordination					10,243	0.40% Of D&I
Travel Costs					19,205	0.75% Of D&I
Owner Project Eng / CM					11,523	0.45% Of D&I
Plant C.M. / Eng Support					16,644	0.65% Of D&I
Plant Gen Conditions					8,450	0.33% Of D&I
Consultants / Miscellaneous Costs					12,291	0.48% Of D&I
TOTAL (D.D.& S) ISBL					**297,291**	
TOTAL OSBL (D+E+F)					**2,857,939**	
Total w/o contingency					24,687,401	
Contingency 10% (range 5% - 20%)					2,468,740	10.00% Of Total
TOTAL (INCLUDES ISBL & OSBL)					**$27,156,142**	

All % are related to M.E. values.
Note 1. Vendor assistance, start up, I/C programming and initial chemicals

Total M.E. multiplier = $27,156,142 divided by $6,237,489 (ISBL & OSBL M.E.) = 4.35

Sales Tax may not be applicable because of sales tax exemption certificate.

Note (1): other items that may need to be considered, expensed costs v' s capital costs, demolition, shutdowns and tie-ins and spare parts.

For revamp / upgrade / modernization projects calibrate the above values by the following.

- Minor revamps multiply by 1.05 to1.15
- Average revamp projects multiply by 1.15 to 1.25
- Major revamps multiply by 1.25 to 1.75 (possibly more for extreme situations)

(5) The following historical return cost data reflects a chemical process facility (liquid / solid process) built in S.E. USA calibrated to the mid point of 2006. M.E. / Process Equipment multipliers / benchmarks, data is based on average direct labor hourly rate $36, to establish union all in rate add 80 – 90%, for union application. For open shop all in rate add 40 – 75% uplift. Cost model is based on 86 # M.E. items costing $9,954,000.

- Total Project = $35.689 million divided by Major Equipment = $9.954 million = 3.58 (note: off-sites not included – off-sites were a separate contract – valued at $4.70 million)

Table 5

HISTORICAL RETURN COST DATA OF A CHEMICAL PROCESS FACILITY (LIQUID / SOLID PROCESS)

		$ MILLIONS BULK MATERIAL		$ MILLIONS BULK LABOR	$36/ HOUR LABOR HOURS	TOTAL IN $ MILLIONS
MAJOR EQUIPMENT (86 ITEMS)						**$9.954**
Freight	3.15% Of M.E.					$0.314
ME install	0.97%	$0.097	3.95%	$0.393	10,922	$0.490
Demolition	0.00%	$ -	2.03%	$0.202	5,625	$0.202
Site Works	2.17%	$0.216	2.80%	$0.279	7,754	$ 0.495
Foundations / Concrete work	3.97%	$ 0.395	2.57%	$0.256	7,117	$0.651
Building structure	9.39%	$0.935	8.59%	$0.855	23,758	$1.790
Pipe	23.09%	$2.298	29.95%	$2.981	82,819	$5.280
Electrical	11.09%	$1.104	14.12%	$1.405	39,040	$2.509
Instrumentation / Control	16.60%	$1.653	5.68%	$0.566	15,718	$2.219
Paint	2.26%	$0.225	2.65%	$0.264	7,326	$0.488
Insulation	3.89%	$0.387	3.86%	$0.384	10,674	$0.772
Fire protection	2.06%	$0.205	2.16%	$0.215	5,981	$0.421
Refractory / Misc items	2.45%	$0.244	3.41%	$0.339	9,424	$ 0.583
TOTAL DIRECTS (A)	**77.95%**	**$7.759**	**81.79%**	**$8.142**	**226,157**	**$26.167**
FIELD IN DIRECTS						
Field supervision	16.04% Of labor					$1.306
Field admin / secretary	1.69% Of labor					$0.138
Field establishment	2.46% Of material					$0.191
Field establishment	2.57% Of labor					$0.209
Consumables	0.87% Of material					$0.067
Small tools	0.88% Of material					$0.068
Construction equipment	7.67% Of labor					$0.624
Construction maintenance	1.45% Of labor					$0.118
Material handling	2.23% Of material					$0.173
Clean up	1.85% Of labor					$0.151

		TOTAL IN $ MILLIONS
FIELD IN DIRECTS (CONT)		
Road maintenance / barriers	2.17% Of labor	$0.177
Vendor assistance	0.89% Of M.E.	$0.089
Contractors fee	2.25% Of directs	$0.589
I/C programming	4.75% Of I/C L & M	$0.105
Spare parts	2.18% Of M.E.	$0.217
TOTAL INDIRECT (B)		**$4.222**
TOTAL (A) + (B)		**$30.389**
ENGINEERING / CM (C)		
EPC firm Detailed design	10.23% 3.109	$3.109
EPC firm Field support (RFI's)	0.35% 0.106	$0.106
EPC firm Procurement	0.57% 0.173	$0.173
EPC firm Construction Mgmt	3.85% 1.170	$1.170
Owners Engineering	0.45% 0.137	$0.137
Owners Construction Mgmt	0.18% 0.055	$0.055
Front End studies	1.48% 0.450	$0.450
Owner General conditions 0.33%	0.100	$0.100
Engineering / CM (C)	5.300	$5.300
TOTAL PROJECT (A+B+C)		$35.689

Table 6

REFINERY / PETRO-CHEMICAL EXPANSION

CATEGORY	$ MILLION	REMARKS
Major Equipment (M.E) 121 items	17.20	693 Design hours / per M.E. item
Freight	0.41	
Setting of M.E. (L&M)	0.87	
Demolition (L&M)	0.21	
Site Preparation (L&M)	0.84	
C/S/A (L&M)	1.88	
Piping (L&M)	8.33	
Electrical (L&M)	2.95	
I/C (L&M)	3.21	
Insulation (L&M)	1.47	
Painting (L&M)	0.44	
Miscellaneous items (F-P, Spare Parts, V.A. I/C programming (L&M)	0.37	
Direct Costs	**38.18**	
Field Establishment / In directs 33.5%	12.79	
Directs + Indirect Costs	50.97	
Detailed Design ISBL 10.5%	5.37	83,900 M.H.' s
CM ISBL 3.20%	1.63	
ISBL Cost	**57.97**	
OSBL (Tank Farm / Loading Facilities)	6.85	
Detailed Design OSBL 7.5%	0.51	7,950 M.H.' s
CM OSBL 2.9%	0.20	
Total Facility	**65.53**	
ME multiplier without OSBL	**3.37**	
ME with OSBL	**3.81**	

(6) Refinery / Petro-Chemical Expansion (SRU) USA Gulf Coast (2004 Costs) Constructed on an established operating site with adequate utilities (needing some upgrading) Costs are based on final close out report:

Excludes: Owner corporate engineering $298,000 and Front End Study $445,000:

Demolition could be an expense item. Refer to previous L & M ratio's to determine man-hours and material splits.

Table 7

GLYCEROL ESTERS / FATTY ACIDS FACILITY

CATEGORY OF WORK	MATERIAL	% OF M.E.	LABOR	% OF M.E.	TOTAL
(A) DIRECT WORK - ISBL / OSBL					
Major Equipment (M.E.) 41 # items	1,985,200	0	0	0.00%	1,985,200
Freight	60,549	3.05%	0	0.00%	60,549
M.E. Setting in place	8,933	0.45%	126,060	6.35%	134,994
Site Work / Preparation	56,578	2.85%	84,371	4.25%	140,949
Piling / Civil / Concrete	141,942	7.15%	171,720	8.65%	313,662
Facilities / Architectural Finishes / Siding	54,792	2.76%	58,563	2.95%	113,355
Structural Steel / Misc platforms	330,933	16.67%	108,590	5.47%	439,523
Piping Systems (40% CS-55% SS)	622,360	31.35%	1,243,728	62.65%	1,866,088
Electrical Systems	312,669	15.75%	225,320	11.35%	537,989
Instrument / Controls	759,339	38.25%	166,161	8.37%	925,500
Paint / Insulation / Refractory	53,600	2.70%	74,842	3.77%	128,442
Fire Protection / Safety	106,407	5.36%	223,335	11.25%	329,742
Off sites / Misc. items See note (1)	155,838	7.85%	139,957	7.05%	295,795
(A) TOTAL DIRECT MAT & LABOR	**4,649,140**	**134.19%**	**2,622,648**	**82.06%**	**7,271,788**
(B) INDIRECT WORK		**% OF M.E.**		**% OF M.E.**	
Trade Supervision / Foreman / Gangers etc.	30,771	1.55%	134,001	6.75%	164,772
Consumable supplies	34,741	1.75%	8,933	0.45%	43,674
Small Tools (items less than $200 per item)	44,667	2.25%	7,147	0.36%	51,814
Site Establishment / Trailers / Temp Offices.	134,001	6.75%	58,563	2.95%	192,564
Safety / Training	3,970	0.20%	20,845	1.05%	24,815
Construction Equipment costs. Rental / Owned.	45,064	2.27%	108,392	5.46%	153,456
Construction Equipment Repairs etc. / Fueling.	10,919	0.55%	25,212	1.27%	36,131
Material Mgmt / Logistics / Field Support	62,137	3.13%	32,756	1.65%	94,893
Testing Activities	5,559	0.28%	5,757	0.29%	11,316
Site Clean Up activities / snow removal	13,896	0.70%	30,771	1.55%	44,667

Hourly Output for Dragline Operations

CY PER HOUR: 90° SWING – OUTPUT PER HOUR

SOIL TYPE	CY PER HOUR									
Drag line Bucket Capacity In C.Y.	1.0	1.25	1.50	1.75	2.0	2.50	3.0	3.5	4.0	5.0
Light Soil or Loam Material	140	185	205	245	260	310	340	360	400	450
Sand Stone or Gravel	135	160	195	215	235	295	320	360	420	510
In place Earth	120	150	185	200	220	245	285	325	355	420
Hard Clay	100	120	150	170	175	210	250	295	325	390
Rock drilled & blasted (Fragmented)	60	85	95	120	125	155	195	210	225	310

Concrete Piles

DATA TABLE

PILE TYPE	UNIT	$ PER LF (LOW)	$ PER LF (HIGH)	UNIT	$ PER M (LOW)	$ PER M (HIGH)
Pre-cast Concrete Piles up to 50' in depth 12" diameter	LF	26.20	34.00	M	85.94	111.50
Ditto 18" diameter	LF	32.00	39.50	M	104.95	129.55
Drilled Concrete piles up to 50' in depth 12"diameter	LF	36.40	44.85	M	119.39	147.11
Ditto 18" diameter	LF	39.90	49.80	M	130.87	163.34
• Add 10% - 20% for drilling through rock.						

Hand pack concrete to u/s of existing Foundations:

3.50 – 6.50 man hours / CY

Steel Sheet Piling:

- Interlocking (left in place): $21.90 / SF
- Ditto removed for future use: $16.65 / SF

Steel Sheet Piling
(Drive & Remove)

DEPTH	$ SF	$ M2
N/E 15' deep	15.70	168.93
16' - 30'	14.80	159.25
31' - 50'	14.20	152.80

GENERAL DATA

All types of excavated material enlarge (swell) up upon excavation or blasting activities to their least dense or loosest condition, by as much as 15% - 35%. As a general rule all excavated materials (soil, sand and rock) will shrink after compaction to a higher density than in the pre excavation (original) state.

Scope Definition / Checklist for Site Work Takeoff:

Initially perform a general examine of the plans, bore logs and specification requirements in detail before trying to organize the take off / estimating effort.

Quantity Take Off Methods

- Plot sections and use average depth below a fixed datum point
- Break out areas / color code areas (cut and or

imported borrow)

- Use contours (if possible) and interpolate where possible
- Determine averages for odd sized areas need to excavated
- Establish average length x width x depth (in feet or parts of a foot) if no specific drawings are available
- Cut and fill (borrow) requirements, establish where borrow will come from.

Clearing / Grubbing General Excavation

- **General Areas:** Acre / Sq Yards
- **Roads:** Acre / Sq Yards
- **Pavement:** Acre / Sq Yards
- **Tree removal / Stumps:** Acre / Each
- **Grubbed and brush areas:** Acre / Sq Yards

Sub Structure / De-watering:

Segregate quantities of common or rock above and below water table.

CONSTRUCTION / BASIC MATERIALS	UNITS
Material types (sand, clay, loam, rock etc.)	Cu Yd
Scrapers (D8's and 663 / dozers / pans) & trucks, etc:	Cu Yd
Specific backhoe / front end loader and trucks etc:	Cu Yd
Ripping requirements; heavy, medium, light (blasting)	Cu Yd
Hand excavation work / Number of lifts	Cu Yd
Foundation preparation, if required / P & S:	Sq Yd
ROCK	**UNITS**
Mass, above 15 ft depth - shovel or loader & trucks	Cu Yd
Intermediate, 5 ft to 15 ft depth - shovel or loader & trucks	Cu Yd
Specific or bottom 5 ft - backhoe, clamshell, etc.	Cu Yd
Hand excavation work / Number of lifts	Cu Yd
Foundation cleanup (special considerations such as Hazardous material)	Cu Yd / Ton
Consider blasted size requirements	Cu Yd

Transportation / Hauls

- Total distance to tip, round trip: Lin Ft / Mile
- On site disposal distance: Lin Ft / Mile
- Hazardous Materials distance: Lin Ft / Mile
- Tipping Fee's: Cu Yd / Ton

Compaction / Bore Log Considerations

- Thickness requirements, 6' or 3" (lifts), 90% or 95% compaction / density:
- Number of passes required and kinds of rollers specified.
- Review any available bore logs to determine water table level, weather rock or unsuitable materials exist.

CORRUGATED PVC DRAIN PIPE IN 3' DEEP TRENCH

(including excavation and backfill):

DIAMETER IN INCHES	MATERIAL PER LF	LABOR PER LF	$ TOTAL PER LF	$ TOTAL PER M
4	1.99	0.80	2.75	9.15
6	2.22	1.04	3.26	10.69
8	3.25	1.25	4.50	14.76

U.G. CONCRETE SEWER PIPE

(excludes excavation and backfill)

DIAMETER	M.H.'S PER 100 LF
4"	24.00
6"	37.50
8"	40.00
10"	44.00
12"	47.00
18"	54.00
24"	75.00

PLACING IN-SITE CONCRETE	M / H'S PER CUBIC YARD		
	By Crane	By Chute*	By Pump
Continuous Footings	0.60	0.30	0.55
Isolated foundations	0.70	0.33	0.60
Elevated slab	0.45	0.63*	0.35
Housekeeping / Equipment pads	0.75	0.70*	0.60

** Wheel barrow / concrete buggy*

Materials for One Cubic Yard of Concrete

1:2:4 mix

- Portland Cement 520 pounds
- Cement 5.30 Cubic feet
- Sand 10.72 Cubic Feet

- Stone 21.12 Cubic Feet
- 37.14 Cubic Feet of material in 1 Cubic Yard of Concrete.

FINISHES (CONCRETE)	MAN HOUR PER 100 SQ. FT. AREA
Steel Trowel Float	1.5
Steel Trowel plus Grinding	3.5
Repair Defects. Fill Form Holes	0.7
Ditto - plus Bag finish	1.5
Ditto - plus Floating	0.5
Power float	1.0
Brush / Broom Finish	1.2
Iron hard	0.8
Curing (Sprayed or Rolled Compound)	0.5
Visqueen / Poly Sheet	1.0
Joint Filler	3.5 / 5.0
Grout, Sand (3) - Cement	6.5 MH's per cu. yd.
Embeco grout	8.0 MH's per cu. yd.
Grouting anchor bolt	0.22 MH's each

Reinforced Concrete 3,500 PSI / 25 MPA Budget Pricing: includes rebar / mesh fabric were applicable, formwork (under slab and edge), concrete material, cranes, pumps, buggies and labor to install (concrete, formwork and rebar), includes 5% waste and 5 to 7 uses of formwork, for quantities 10 CY / 10 M3 and above: Labor is based on merit shop labor (hybrid of union and non-union). For applications with a high rebar content use higher value. (2017 Cost Basis). See chart on next page

Adjustment

- For excavation and backfill add 5% – 15% to values on next page.
- For quantities less than 10 CY / M3 add 25% - 50% to values on next page.
- For 2,500-PSI - 17.5 MPA application multiply values on next page by 0.95
- For 3,000-PSI - 20 MPA application multiply values on next page by 0.97
- For 4,500-PSI - 30 MPA application multiply values on next page by 1.06
- For slab on grade stone add 10% - 15% to values on next page.

For applications in major US cities such as New York, Chicago, Philadelphia, Los Angeles etc add 10% - 22% to values on next page.

Pounds / Kg / SF of rebar in CY / M3

DATA TABLE

POUNDS / KG / SF OF REBAR & FORMWORK IN ONE CY / M3 OF CONCRETE	LOW	AVERAGE POUNDS / CY OF CONCRETE	HIGH	KG / M3 OF CONCRETE	LOW	AVERAGE SF OF FORMWORK PER CY OF CONCRETE	HIGH
Footings (spread)	30	75	100	33	10	25	35
Isolated Foundations	35	88	140	38	10	25	35
Pipe Rack foundations	40	95	150	40	10	25	35
SOG	40	85	130	40	7	15	20
Suspended Floors	55	128	200	65	20	40	70
Walls 12"	40	95	150	40	25	50	85
Columns & Beams	70	160	250	105	30	65	100

Reinforced Concrete 3,500 PSI / 25 MPA Budget Pricing

DATA TABLE

DESCRIPTION	$ COST PER CY		$ COST PER M3	
	LOW	HIGH	LOW	HIGH
CONCRETE FOUNDATIONS				
Footings 3' x 1'	269	331	351	431
Mat foundation	269	372	351	486
Pile caps 3' x 3' x 3'	269	403	351	532
SLAB ON GRADE (EXCLUDES U/S STONE)				
4" thick	235	331	308	430
6" ditto	235	331	308	430
8" ditto	235	331	308	430
WALLS				
6" thick	449	763	588	999
9" thick	449	763	588	999
12" thick	449	763	588	999
ELEVATED SLAB / WAFFLE SLAB / FLAT WORK				
4" thick	470	562	616	736
6" thick	470	562	616	736
8" thick	470	562	616	736
COLUMN / BEAMS				
18" x 18"	793	1,044	1,038	1,367
24" x 24"	793	1,044	1,038	1,367
Stairs and landing	729	1,510	955	1,978
PLINTHS / HOUSEKEEPING PADS (LESS THAN 5 CY / M3)				
Isolated pads	793	1,589	1,038	2,082

Occupancy Load Pounds / Square Foot

DATA TABLE

TYPE OF FACILITY	OCCUPANCY LOAD POUNDS / SQUARE FOOT
Admin / Office Facility 2 Floors	70 – 120 PSF
Admin / Office Facility 4 Floors	100 – 300 PSF
Manufacturing Facility 2 – 4 Floors	150 – 350 PSF

Concrete Rebar in Walls: (Based on 10' high wall)

DATA TABLE

WALL THICKNESS	POUNDS OF REBAR PER SF	AVERAGE	KG PER M2	AVERAGE
6"	1.00 – 2.00	1.50	4.90 – 9.78	7.34
9"	1.25 – 2.50	1.87	6.11 – 12.23	9.17
12"	1.75 – 3.50	2.62	8.55 – 17.12	12.84
15"	2.00 – 4.50	3.25	9.78 – 22.00	15.90
18"	2.40 – 4.80	3.60	11.74 – 23.48	17.61
21"	2.75 – 6.00	4.38	13.45 – 29.35	21.40

HOURS TO INSTALL 50 CY OF REINFORCED CONCRETE

WORK ITEM	QUANTITIES	MAN-HOURS
Form	350 SF	120
Strip / Repair / Reuse	350 SF	50
Rebar	500 #	90
Install concrete	50 CY	100
HD Bolts	1 set	25
Grout	1 item	25
Total	**50 CY**	**410 / 8.20 hours per CY or 10.75 hours per M3**

CAISSON CONCRETE 3,500 PSI REINFORCED

DIAMETER	CU YD / LF
12" Diameter	0.029 Cu Yd / LF
16" Diameter	0.051 Cu Yd / LF
18" Diameter	0.066 Cu Yd / LF
24" Diameter	0.117 Cu Yd / LF

CONCRETE STRENGTH EXPRESSED IN PSI (POUNDS PER SQUARE INCH) AND METRIC UNITS - MPA (MEGA PASCAL'S)

PSI	MPA (APPROX)
2,500	17.5
3,000	20
3,500	25
4,000	30
4,500	30

Concrete Pumping: Based on 100 CY / 75 M3

The following rate is for the pumping activity only, excluded final placing of the concrete:

- Per Cubic Yard $8.80 - $13.85 / CY
- Per M3 $11.53 - $18.15 / M3

Formwork: Material cost and man hours per 1 SF of Contact area timber formwork with plywood and timber or metal framing with associated cast in place connections / bolts: Cost basis 2017

Rule of thumb for formwork is 10 – 20 SF of formwork per one cubic yard of installed reinforced concrete.

See next page for chart

FORMWORK – ERECT, STRIP AND REPAIR

APPLICATION	MAN-HOURS SF	MAN-HOURS M2
Formwork to u/s of suspended floors	0.12 - 0.18	1.30 - 1.95
Formwork to walls	0.10 - 0.15	1.08 - 1.65

Formwork and Rebar Quantities

DATA TABLE

TYPE OF CONCRETE	SF PER CY OF CONCRETE	POUNDS OF REBAR PER CY	M2 PER M3 OF CONCRETE	KG OF REBAR PER M3 OF CONCRETE
Stanchions	20 – 30 SF	60 - 70	98 - 147	36 - 42
Pile Caps	30 – 40 SF	70 - 100	147 – 196	42 - 60
Beams	70 – 100 SF	120 - 170	342 - 490	73 - 103
Columns	70 – 100 SF	120 - 170	342 - 490	73 - 103

Formwork

COST BASIS 2017

APPLICATION	FABRICATE & ERECT & DISMANTLE 1ST USE	ERECT, CLEAN & REPAIR 2 USES	ERECT, CLEAN & REPAIR 3 USES	ERECT, CLEAN & REPAIR 4 USES	ERECT, CLEAN & REPAIR 5 USES	ERECT, CLEAN & REPAIR 10 USES
Isolated foundations	Materials $3.20 1.25 hours	Materials $0.66 1.00	Materials $0.68 0.90	Materials $0.68 0.80	Materials $0.68 0.70	Materials $0.68 0.70
Walls 10' high	Materials $3.45 Labor 1.50 hours	Materials $0.75 1.25	Materials $0.75 1.15	Materials $0.75 1.05	Materials $0.75 0.95	Materials $0.75 0.95
Elevated columns & beams	Materials $6.07 Labor 2.25 hours	Materials $1.26 2.00	Materials $1.30 1.90	Materials $1.30 1.80	Materials $1.30 1.70	Materials $1.30 1.70
Elevated floor slabs	Materials $4.30 Labor 1.00 hours	Materials $0.87 0.75	Materials $0.89 0.65	Materials $0.89 0.55	Materials $0.89 0.45	Materials $0.89 0.45

Pre-Cast Concrete Floor Slabs (Elevated) 3,000 PSI Concrete:

SOLID OR HOLLOW 3,500 PSI CONCRETE STRAPPED AND GROUTED

FLOOR THICKNESS	MATERIAL COST PER SF	INSTALLATION MAN-HOURS PER SF	MATERIAL COST PER M2	INSTALLATION MAN-HOURS PER M2
4"	$6.20	0.15	$66.71	1.60
6"	$7.45	0.17	$80.16	1.83
8"	$8.01	0.20	$86.19	2.15
10"	$9.48	0.23	$102.00	2.48

- *Excludes crane costs:*
- *For areas larger than 25,000 SF / 2,323 M2 multiply installation hours by 0.85*

Pre-Cast Concrete Wall 3,500 PSI Reinforced Concrete

(INSULATED WITH BATT INSULATION 0.50 – 1.00 INCH):
TILT –UP AND INDUSTRIAL APPLICATIONS:

FLOOR THICKNESS	MATERIAL COST PER SF	INSTALLATION MAN-HOURS PER SF	MATERIAL COST PER M2	INSTALLATION MAN-HOURS PER M2
3"	$4.50	0.20	$48.42	2.15
4"	$5.50	0.20	$59.18	2.15
5"	$6.90	0.25	$74.24	2.70
6"	$7.66	0.25	$82.42	2.70

- *Excludes crane costs:*
- *For areas larger than 25,000 SF / 2,323 M2 multiply installation hours by 0.85*

Slab on Grade (SOG) Concrete Floors: includes supply and installation complete with concrete, formwork and rebar, includes 4" thick sub base and polythene.

THICKNESS OF WALL	$ SF	S M2
4" - 200 mm	7.98	$85.86
6" - 250 mm	9.62	$103.51
9" - 225 mm	11.20	$120.51

Concrete Walls: includes supply and installation complete with concrete, formwork and rebar.

THICKNESS OF WALL	$ SF	S M2
4" - 200 mm	23.40	$251.78
6" - 250 mm	25.35	$272.77
9" - 225 mm	26.90	$289.44

Pipe Bridge

BUDGET PRICING INCLUDES FOUNDATIONS AND STRUCTURAL STEEL (2017 COST BASIS)

TYPE	MATERIALS PER LF	MAN-HOURS TO INSTALL PER LF	MATERIALS PER M	MAN-HOURS TO INSTALL PER M
Light Duty	78.80	1.77	$258.46	5.80
Heavy duty	119.95	2.33	$393.44	7.64

Reinforced Concrete Data: Using $523 per CY $684 per M3 for installed concrete as a benchmark for concrete: The approximate break out of this cost would be as follows:

CATEGORY	COST PER CY	COST PER M3	%
Concrete	$105.00	$137.00	20%
Rebar	$175.00	$228.50	33%
Formwork	$243.00	$318.00	47% (20% M – 80% L)

As a rule of thumb for a quick method of estimating concrete, there is typically 100 – 200 pounds of rebar in 1 CY of reinforced concrete or 55 kg – 110 kg in 1 M3

Use the above ratio's to determine approximate values for rebar and formwork.

Gunite / Sprayed on Concrete: For applications using mesh reinforcement add $0.63 – $1.48 to material cost and add 10% to installation man-hours: See chart below.

Injection grout / Concrete: (1:3:6) mix: (includes batching plant and pressure pumps, excludes drilling costs)

- $640 - $800 / CY
- $840 - $1,045 / M3

Gunite / Sprayed on Concrete

BUDGET PRICING

THICKNESS	MATERIAL COST PER SF	INSTALLATION MAN-HOURS PER SF	MATERIAL COST PER M2	INSTALLATION MAN-HOURS PER M2
1"	$4.03	0.10	$43.36	1.08
1.5"	$4.76	0.12	$51.22	1.29
2.5"	$8.05	0.17	$86.62	1.83
3.0"	$9.60	0.22	$103.30	2.37

CONCRETE GENERAL ESTIMATING DATA

TYPE	PER SF	PER M2
Bush hammer concrete	$0.62 - $1.30	$6.67 - $14.00
Acid wash concrete	$0.23 - $0.40	$2.47 - $4.30
Pattern concrete slabs	$0.50 - $0.84	$5.38 - $9.04
Colorize concrete slab	$0.57 - $1.05	$6.13 - $11.30
Bag / Dress concrete walls	$0.30 - $0.75	$3.23 - $8.07

Estimating Thoughts for Structural Steel and Miscellaneous Steel

Obtain and review any available engineering deliverables / drawings or sketches. Take off lengths of steel section and multiply by appropriate weight in pounds per LF, determine pounds / tons of steel that is depicted on the drawings. Structural steel is usually fabricated in a vendors shop, and delivered to the site for eventual erection. Structural steel has a number of differing specifications / materials of construction, that have differing cost consequences the most widely used is A36.

Issues that may perhaps impact the erection activity of new structural steel are:

- Lifting equipment / cranes / hoists
- Mobilization / de-mobilization of crane (crane are typically rented by the day or week)
- Crane reach
- Lifting capacity
- Number of floors
- Bolted connections
- Welded connections
- Painting / touch up painting

Platforms, ladders, handrails, stair risers and other miscellaneous: perform take off and establish pounds / tons of material and assign appropriate installation man-hours. Checker plate, grating and floor plate and metal decking: perform take off and establish square feet of material and assign appropriate installation man-hours, allow at least 5% for waste in the cutting / fit up activity.

Order of Magnitude Structural Steel Estimating Data

Structural Steel weights per SF:

- Manufacturing Building = 10 - 15 lb / S.F.
- 5 Floor Office Building = 15 – 25 lb / S.F.
- Heavy industrial Facility = 25 – 75 lb / S.F.
- Process Structures: Preliminary weights of structures can vary from 1.5 lb to 3.5 lb (Cubic Foot of enclosed area).

Structural Steel as percentage of major equipment cost: usually falls in the 5% to 8% of major equipment cost. The following pie chart delineates the various cost / fabrication and installation activities associated with structural steel.

PERCENTAGE BREAKDOWN OF STRUCTURAL STEEL BASED ON 500-TON, 3-STORY BUILDING: