Designing with Cost in Mind

Executive Summary. Contractors are often brought into a project in the design phase to minimize cost. Here are some guidelines on infrastructure project cost cutting measures from a Contractor's viewpoint – it's advice to a design team.

How estimating is done. In civil infrastructure work, most contractors use crew-based methods for estimating. This means that each and every activity on the job is built by a crew performing their work at a certain production rate. For example, a pipe crew installs X lineal feet a day. A rebar crew installs Y number of tons per shift (also known as a day). And lastly, a bridge beam erection crew sets a beam in Z hours. This varies significantly from unit price estimating wherein a book full of average unit prices is opened and applied to takeoff quantities.

Components of cost in a bid. A bid has very few cost components: labor, equipment, subcontractor, material, and let's say, other. That's it. Five (5) types of cost. Yes, there's escalation, tax, labor fringes, overhead, insurance, bond, freight, and certain regional specialty costs like ghost riders. Anyway, if an owner or designer can think in these basic terms, the cost can be minimized. The following chart provides some thinking points for an owner and his/her engineer.

My story. I've been brought in numerous time to help a designer improve a design. And frankly, one of my favorite parts of the business is value engineering. There's a lot designers can learn from contractors. The biggest benefit and owner can get from their designer is their ability to listen to the contractor or their firsthand experience in the field of seeing the work.

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Cost

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Affecting Cost Through Design & Contract

Project Aspect	Variable		Affecting Cost			
	Macro	Micro	How to cost your project more money.	How to decrease cost of your project.	Why/How does this affect cost?	Tip/Trick
Time	Project Duration		Require completion in an unreasonable time.		Requires the contractor to work overtime and to increase crew size, or add manhours, to accomplish tasks because (s)he expects to have inefficiency and construction mistakes due to the fast-paced work.	Put out as much of a quality design as you can and scope reduce the rest. The alternate is putting out an incomplete design to be built in an unreasonable time and the cost of construction will be magnitudes above what it would have cost during design. The cost of yellow iron and union workers far outweighs pointdexters and laptops.
	Work Hours		Mandate a daily construction period shorter than eight hours.	Extend working hours to a minimum of 8 hours per day and Saturdays.	Crews are never able to get over the learning curve of a construction activity. More time is spent setting up and taking down than producing actual finished product.	Consider night work to extend duration of the workday; however, be prepared for some increased cost there also. Night work is often bid at less productive rates because the crews are in the dark - it's both safety and production that can suffer.
Access	Work Area Access		Limit the access to the work area.	Allow greater access.	Limited access means more hoisting. Hoisting is slow, dangerous, equipment intensive, and therefore expensive. It also has greater labor requirements in hourly wage and a requirement for oilers and/or riggers.	Access isn't just in two dimensions. Access is below and above as well. If your project has overhead utilities, try to get them removed prior to arrival of your contractor.
Weather	Time of Year for Construction		Work in difficult weather conditions.		When it's too cold asphalt and concrete cannot be placed. When it's too hot, workers tire quickly. When it's too rainy, dirt turns into mud. There's no perfect answer.	
Constructability	Clearing		Require offhaul of green waste.	Allow onsite disposal via bury, burn, or mulching.	Hauling costs money: each load is hauled by a person in a piece of equipment. Both the human in the seat and the truck costs a certain amount per hour. Then there may be dump fees and/or processing (spreading) fees at the dump site.	
	Earthwork	Offhaul	Require offhaul of surplus material.	Balance the earthwork quantities.		The earthwork takeoff software likely allows the user to lower or raise the project's overall grade in 0.1' increments. This can significantly modify the quantities. Your most economic option is probably to balance the earthwork on site (unless it's a valuable commodity, like gravel, that you can sell!).
		Asset Valuation		Value your soil and sell it.	If the earth under your site is gravel or sand, this may be a valuable commodity. In a rainy area your supply of gravel to your own site, or to others in the area, can be a revenue producer.	
		Material Production		Produce your project's aggregates.	Producing aggregate on site minimizes haul time, may decrease labor costs, and may decrease equipment costs if the owner buys the equipment.	Invest in your own crushing equipment. Rock excavated on your site can be sized for pipe bedding and backfill or for general fill needs.
	Pipelaying	Material Selection	Use heavy pipe.	Use light pipe.	Heavy pipe requires larger equipment and takes longer to move.	
		Depth	Install it deep.	Keep the pipe shallow.	Deep excavating cost money in shoring and ultimately lead to less feet of pipe being installed per day. Also, going deeper may result in hitting rock layers or groundwater. This costs more money.	
		Restraint Method	Thrust blocks.	Use locking gaskets.	Locking, or restraining, gaskets are installed almost identically to a regular gasket. Very little impact on production/labor costs.	
				Use exterior pipe joint restraints.	Although a small increase in labor and equipment, the cost is much less than thrust blocks.	
	Retaining Walls	Material Selection	Cast in place walls.	Precast or pre-engineered systems.	Cast in place concrete walls are large quantities of materials of varying types (ready mixed concrete and rebar). This is all installed on site by labor. It's slow and labor intensive.	Consider precast structural earth walls, gabion baskets, or burrito faces.
Work Rules	Local Use of Labor		Mandate that a certain percentage of workers must be from a certain geographic area.		Introducing new workers into existing crews disrupts labor harmony and production. This takes away the advantage of labor efficiency because crews have to introduce new members.	Contractors often add manhours into a bid as pure cost knowing that the efficiency will be zero with these workers. It's nothing but wasted money.
	Dictated Crew Compositions		Employ workers who mandate a number or type of employee be used to perform a certain function.	Use companies which dictate their own crew compositions.		This is a fundamental choice to be made by an owner: do I go union or non-union? There are pros and cons of both. Unions have work rules which, to some degree, mandate crew sizes.
Owner Involvement	Owner Furnished Materials	Simple material like fuel or concrete.		Provide this material at no cost to your contractor.	Simple products like these, if well managed by the owner, prevent the owner from paying markup (say 3% to 20% of the cost of the material). However, if mismanaged and the contractor is standing by waiting for your delivery of this material, the owner will incur standby costs.	Make sure the access to the material is not restricted. For example, if you are a fuel refiner, devote a pump(s) to your contractor. If you are providing the concrete, ensure that the plant is for the exclusive use of your contractor.
		Complex materials like large, specialty sewage pumps.	Get involved in the contractor's operation.	Stay out of the contractor's way and let him/her be responsible for his/her own destiny.	Supplying labor (i.e. plant workers, flaggers, maintenance personnel) into an operation or to supplement a crew, forces a contractor to wait on these resources or to add new, unknown members to a team. This more often than not costs the project more money and ultimately shifts significant risk to an owner.	
	Owner Furnished Labor		Mandate Owner furnished labor in production activities.	Require the Contractor to provide all of his/her own labor. This is what they do for a living.	Using Owner furnished labor (like operators, police officers, laborers, or flaggers) can cost more money to th eproject based on inefficiencies introduced in the productoin work or, simply, in waiting for these members to show up to the site.	

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