Show Me the Money: The Real Savings in Tunnel Contract Payment Provisions

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Abstract: Bidders read the contract general conditions for projects under consideration for bid before committing to the expense of preparing a bid. This is a smart practice because it oftentimes reveals that the payment terms dictate that the bidder must either add significant financing costs or front-load the bid to obtain a reasonable cash flow. While the industry has made *qualitative* recommendations to reduce financing costs and discourage unbalanced bids for common contract clauses relating to retention, capped mobilization, the timing of their payment, and the use of equipment mobilization items, there has been no attempt to *quantify* these savings. By use of a "typical" example tunnel contract, this paper first guides the reader through these payment provisions while quantifying their savings. It then concludes by reinforcing the message that when owners do not consider contractor cash flow in the contract language, they are ultimately either subsidizing significant financing costs or receiving unbalanced bids, and calls for engineer's estimates to have the ability to make these analyses to owners' benefit.

INTRODUCTION

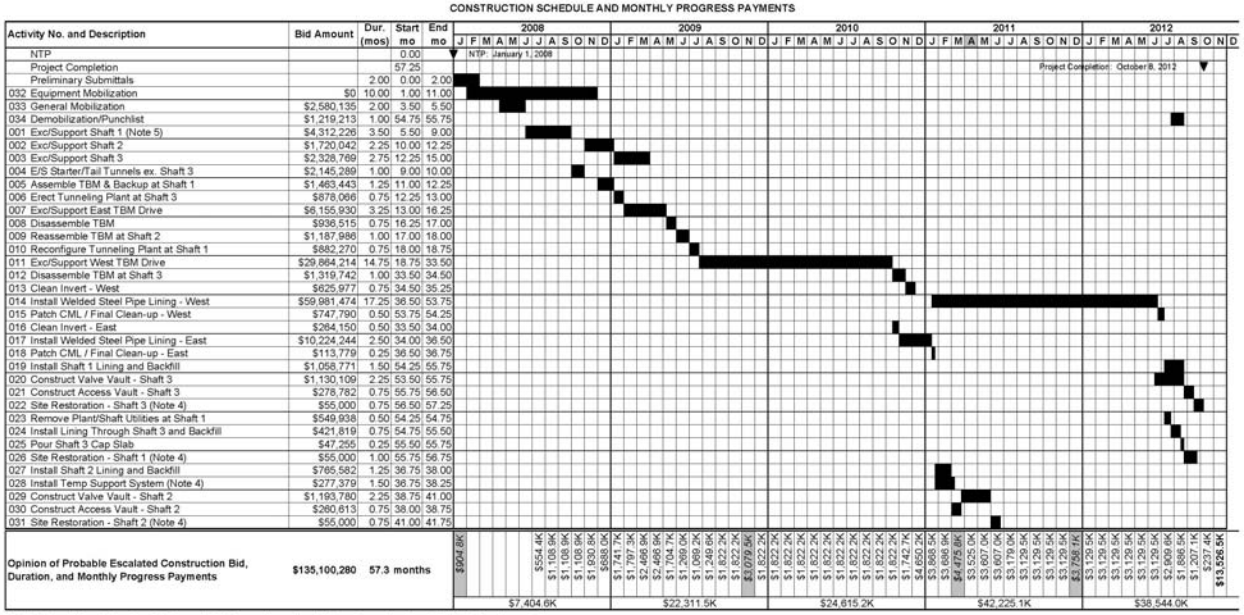
It is generally accepted that tunnel construction costs more and is generally riskier than other kinds of construction. It is therefore in the owners' interests to reduce costs and risks when they have the ability to do so. Contractor financing costs are the low-hanging fruit that can be picked with minimal effort and risk by simply tailoring tunnel construction payment methods and provisions to reduce contractor financing costs. Added benefits include a measure of certainty that bidders are less likely to unbalance their bids—or at least unbalance them to a significantly lesser extent—while reassuring owners that they are not paying a disproportionately high amount relative to contract work completed. This in turn tends to reduce the quantification of disputes since it gives owners more confidence that the contract costs they can analyze are based on some measure of reality

While many owners have employed these recommended practices, they have done so using qualitative arguments to justify their rationale. These qualitative arguments may be sufficient, but for those who demand a more rigorous accounting, some method must be used to quantify the savings. Owners who do not have the resources to make these analyses during the design process should find the following of interest as a rough measure of the possible amount of financing costs that may be included in a balanced bid.

A TYPICAL TUNNEL CONTRACT

The basis for this discussion is a tunnel construction contract recently prepared for a client. The figures presented are censured scans taken from the estimate itself.

The project cost-loaded schedule is shown in Figure 1. The work involves the construction of a long tunnel with shaft access using a hard-rock tunnel boring machine (TBM) and requiring a final lining. The $135M project requires about 57 months of construction, including a 10-month TBM procurement period, time to develop the shaft access for two TBM drives (taking 3 months and 15 months, respectively), followed by 17 months of final lining. Progress payments average about $3M per month. In addition to the $4M in fleet equipment, the contractor purchases an additional $18M of equipment for the job, including $13M for a new main-beam TBM and trailing gear, of which 90% is written off to the project because of the long length of tunnel. About $15M is devoted to shaft and permanent surface works. The contractor has included about $20M, or about 15% of cost in markup. Cost items are grouped into bid items, and the bid items themselves are balanced in accordance with contract requirements.



1. Project calendar is based on 9 observed holidays and no critical inclement weather days distributed evenly over the year.
2. Payments are made 30 days after pay applications including 10% retention which is released with the final payment. Payments releasing retention bolded. 50% of the contract is earned 40 months after NTP (Apr 2011).
3. Spread $67.0M indirects + $9.4M escalation - $3.8M mob. Mob/demob paid on Earned Value net of mob/allowances: 50% at 20%EV; 75% at 50%EV, and 100% at 75%EV. Bond paid at NTP. Payments including mob/bond italicized/shaded.
4. Indirect costs spread limited to a 10% subcontract markup.
5. A schedule factor has been applied to this activity so that the number of estimated workdays for the cost item takes place in the number of calendar days scheduled.

Figure 1. Cost-loaded schedule for a typical tunnel project

Figure 2 below shows the cash flow for this balanced bid and provides the details of the base project payment provisions. Refer to the glossary at the end of this paper for an explanation of parameters.

The financing costs are the costs of money for the difference in the timing of revenue relative to expenses. The base scenario reflects various payment conditions identified by the chevron bullet items. This includes a requirement for withholding 10% of earnings, capping mobilization payment to 2.5% of the contract value, making payments for mobilization at 20%, 50%, and 75% of earned contract value (EV), and the absence of an equipment mobilization bid item.

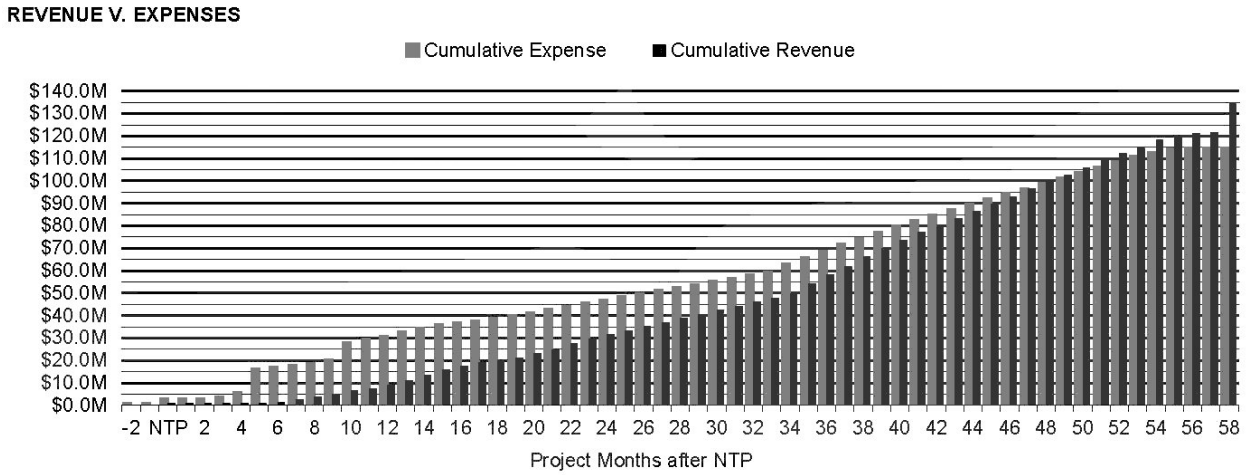


Figure 2. Cash-flow base scenario

Looking at the cumulative expense plot, one can see there is an initial disbursement at the time of award (taken to be 2 months prior to issuance of Notice to Proceed) for replacement of the bid bond with a performance bond. This is followed by a short period of relatively low expenditures during the contract submittals and planning phase. After approval of the work plan submittals, there is a significant increase in spending for equipment procurement and mobilization.

On the revenue side, there is very little activity in the beginning months of the project since project payments are limited to tangible contract progress. Thus, 10 months into the work the contractor has received about $6M in progress payments but has expended almost $30M to gear up for the work ahead. This huge deficit is maintained over the next 4 or 5 months and then slowly eroded over the course of the work until in month 48 it is finally erased, and the contractor is now operating in the black for the remaining 10 months. Note that with the release of final retention, the contractor receives its profit on the job.

This is a dramatic display of what results from a balanced bid requirement coupled with an ideal contractor not concerned with bidding climate: a significant financing cost to the owner of just over $3M, or 2.2% of the project bid. Keep in mind that the relative fractional contribution of financing cost to project cost is a function of many variables, not the least of which is the magnitudes of and relative differences in the interest rates for borrowed and invested capital.

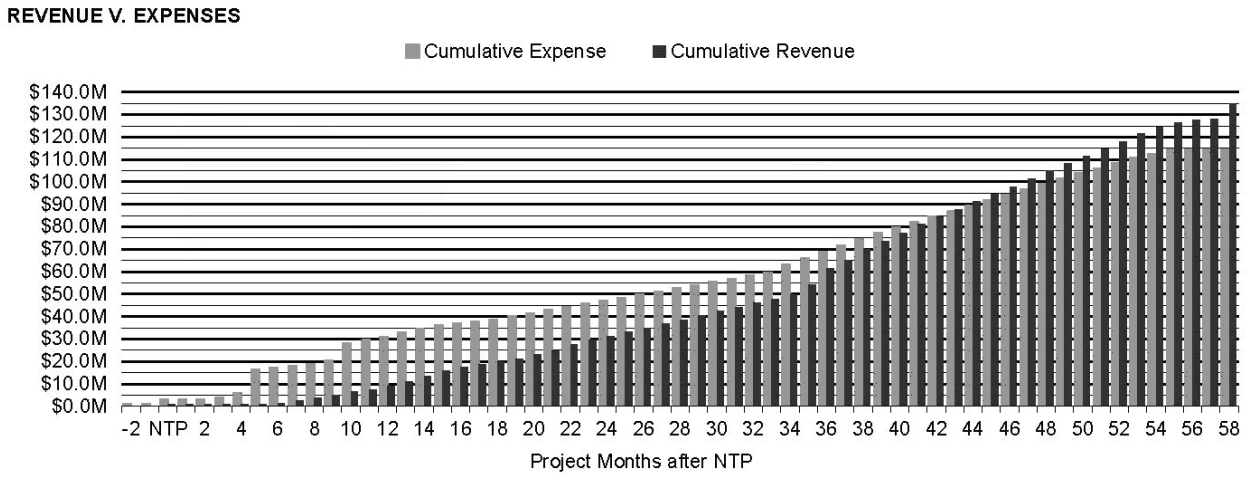
CASH-FLOW SCENARIOS

The following scenarios are made to provide an indication of relative savings that can be expected by modification of the above base contract payment language. Again, keep in mind that the amount of savings for each scenario is a function of many variables that are likely to change with both project specifics and commercial terms but which nevertheless provide a useful gauge of approximate savings.

Retention

All construction contracts call for retention on earnings. In many cases, this requirement can be satisfied by the substitution of securities in lieu of cash retentions, and it should be noted that the models presented herein are based on this assumption. Figure 3 shows the effect of modifying the base cash-flow scenario to reflect a reduction in the

amount of retention at the 50% EV milestone. At 50% of earned contract value, retention is reduced from 10% to 5%.



SUMMARY PARAMETERS

Interest rate on borrowed capital	5.5%	(nmf)	Modified Internal Rate of Return	Model closure error: 0.00%
Interest rate on investment capital	2.0%	$2,674,300	Net project investment cost	Cashflow positive in month 43

» Retention is 10% reduced to 5% at 50% of earned value in month 36; Progress payments lag pay applications by 30 days.
» Mob/demob paid on Earned Value net of mob/allowances: 50% at 20%EV; 75% at 50%EV, and 100% at 75%EV. Bond paid at NTP.
» The 2.5% contract cap delays $1,843K in revenue payments.
» Equipment purchases total $18,099K: Contractor pays 10% in month 0, 50% in month 5, and 40% in month 10.
» $134,719K in revenue - $114,417K in expenses = $20,302K markup.

Figure 3. Base cash-flow scenario reflecting a reduction in retention of 5% from 10% at 50% EV

As can be expected, the effect of this modification is less successful at reducing initial negative cash flow since it does not take effect until after 50% of the contract is earned. Nevertheless, it does generate a modest spike in revenue at month 36. It also moves the transition from negative to positive cash flow by 5 months, or about 10% of the contract time, resulting in a decrease in financing costs of some $350K, or almost 0.3% of the contract price.

Mobilization Cap and Payment Schedule

Many owners specify contract caps on the amount bid for mobilization as a means of assuring that contractors do not front-load this item. Usually demobilization is included in the mobilization item. There may be some recognition that mobilization for smaller projects has a higher amount of mobilization relative to contract price, and so these caps may be graduated based on contract price. In the base example, mobilization was capped at 2.5% of the bid in recognition of the $120M to $150M contract value, but this cap did not reflect the contractor's actual cost for mobilization and demobilization. Figure 4 shows the scenario for a 5% contract cap, which more accurately reflects the actual costs for mobilization and demobilization without regard for equipment procurement costs.

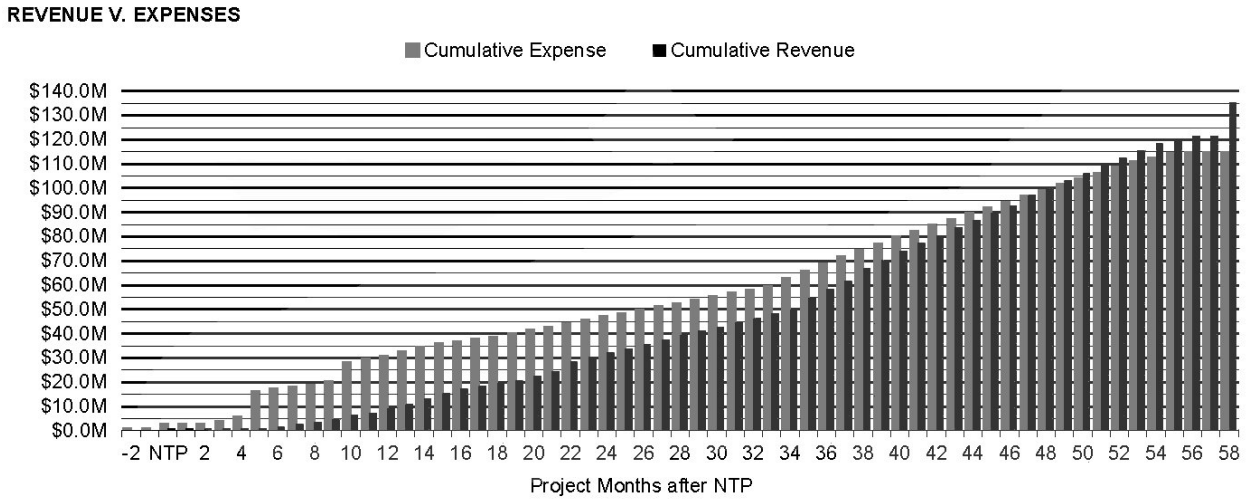


Figure 4. Base cash flow scenario reflecting a mobilization cap that reflects actual cost

While the effect of this modification is to more accurately reflect the actual cost of mobilization, its effect on curtailing financing costs is negligible: the positive cash flow point changes only marginally, reducing financing costs by a negligible amount. The reason for this is that the *timing* of the mobilization payments in Figure 4 is not a better fit to the actual stream of mobilization expenditures. Figure 5 below shows that if more attention is paid to the timing of mobilization payments, the reduction in financing costs is more significant at $415K, or 0.3% of the contract value.

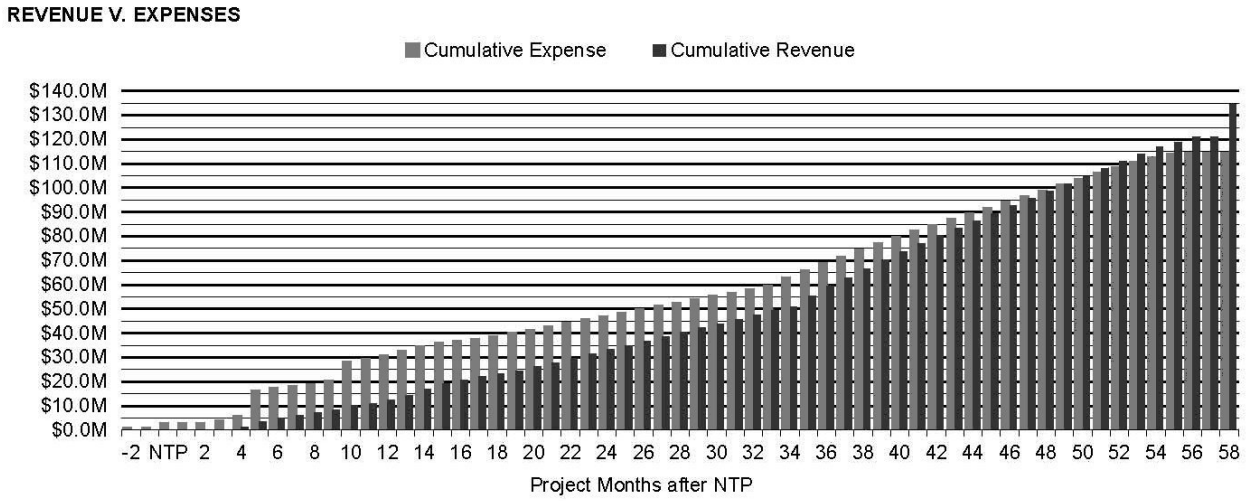
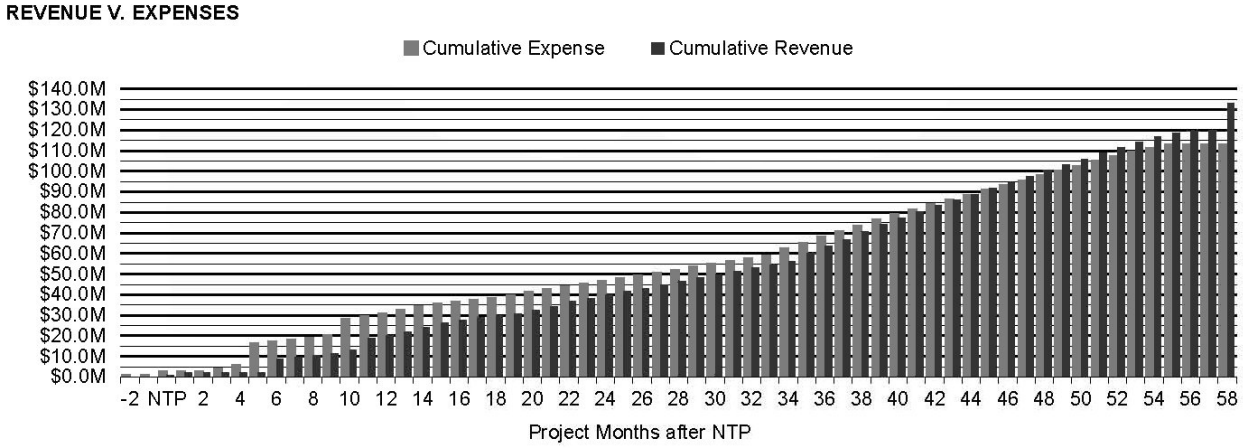


Figure 5. Base cash-flow scenario reflecting a better tuned mobilization payment schedule

Separate Equipment Mobilization Item

The largest influence on financing cost is the cost of specialized tunnel equipment, as evidenced by the large expenditure spikes starting in month 10 of the base scenario cash-flow profile. Figure 6 shows how the effect of these spikes can be softened by use of an equipment mobilization item that makes timely payments to the contractor in response to these expenditure surges.



SUMMARY PARAMETERS

Interest rate on borrowed capital	5.5%	(nmf)	Modified Internal Rate of Return	Model closure error: 0.00%
Interest rate on investment capital	2.0%	$1,315,200	Net project investment cost	Cashflow positive in month 43

» Retention is 10% through substantial completion; Progress payments lag pay applications by 30 days.
» Mob/demob paid on Earned Value net of mob/allowances: 50% at 20%EV; 75% at 50%EV, and 100% at 75%EV. Bond paid at NTP.
» The 2.5% contract cap delays $1,868K in revenue payments.
» Equipment purchases total $18,099K: Contractor pays 10% in month 0, 50% in month 5, and 40% in month 10.
$13,335K of this is reimbursed as Equipment Mobilization on the same schedule that purchases are made but lagging by 30 days.
» $133,259K in revenue - $113,026K in expenses = $20,233K markup.

Figure 6. Base cash-flow scenario reflecting an equipment mobilization item

Note that equipment mobilization only covers the main-beam TBM, the trailing gear, and an allowance for their erection and commissioning in an amount of $13.3M. The actual equipment procurement costs are about $18M in addition to $4M in book value for fleet equipment. Nevertheless, the contractor receives payments in some structured fashion over the 10-month equipment procurement period that result in a significant $1.7M reduction in financing costs, or 1.3% of the contract price. Note that it is not necessary to cover all equipment purchases to generate this magnitude of savings in financing costs.

Cumulative Effects

The cumulative effect of the above-described modifications to retention, general mobilization language, and the use of an equipment mobilization item is shown in Figure 7.

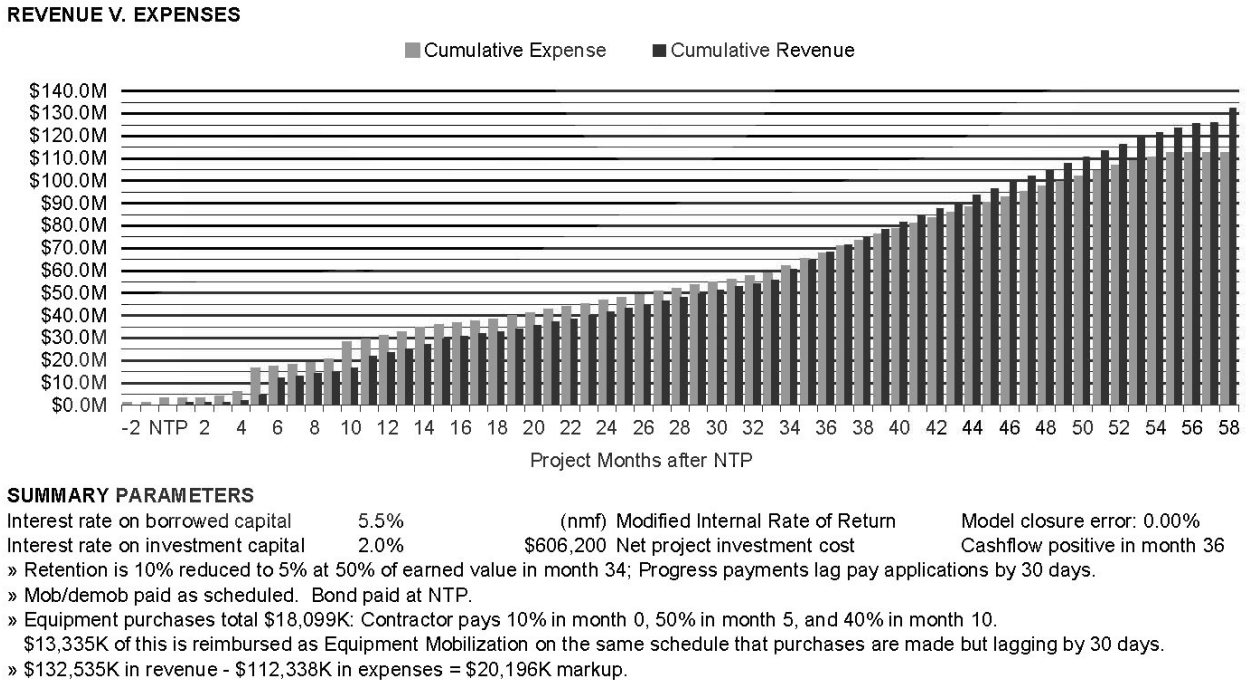


Figure 7. Base cashflow scenario reflecting all measures

Financing costs have been reduced by an impressive $2.4M—almost 2% of the contract value—from $3.0M to $0.6M. The turning point to positive cash flow—the point at which the project can sustain itself—has been shifted from the 83% completion point to the 62% completion point. Note that the sum of the parts is not equal to the whole because the measures that improve cash flow earliest dilute the cash-flow imbalance for those that improve cash flow later.

SUMMARY

Real savings are possible by minimizing contractor financing costs, encouraging more balanced bids, and providing a more accurate measure of earned value. The forgoing example of a typical tunnel construction project shows that these measures can reduce financing costs by about 80%. Since financing costs can contribute in excess of 2% to project costs, these measures are a relatively easy and risk-free way to reduce project costs a significant amount.

When owners do not have the ability to determine these savings in justification of amending standard contract payment language, the example presented herein provides a rough order of magnitude of the dollars involved. For those engineer's estimates that calculate these costs, a project-specific analysis can easily be made to quantify these savings for the owner's benefit. However, considering the size of these financing costs, it is recommended that owners require their engineer's estimates to be capable of making these assessments.

GLOSSARY

Cumulative expenditure: For any month, the sum of all expenditures charged to the project, including the interest expense for prior months.

Cumulative revenue: For any month, the sum of all contract payments to the project, including the interest income for prior months.

Interest rate on borrowed or invested capital: Shown as a nominal interest rate. The period interest is 1/12th of the nominal rate. When the cumulative project cash flow for any month is negative (positive), the investment cost is calculated using the borrowed (invested) rate.

Model closure error: This identifies how well the cash-flow model independently arrives at total project cost. The error is typically zero; however, slight errors can be generated by the assumptions in the timing of expenditures for escalated estimates relative to where the escalation period rate date begins.

Modified Internal Rate of Return (MIRR): The discount rate that makes the net present value of all cash flows from a particular project equal to zero. This differs from the conventional method of calculating Internal Rate of Return (IRR) because with IRR, both the borrowing/investing rates are the same, whereas MIRR allows these borrowing and investment rates to be different.

The MIRR metric by itself does not identify the desirability of undertaking a particular project (other than in general, the higher a project's internal rate of return, the more desirable it is to undertake the project). Rather, MIRR should be used to rank different prospective projects that a contractor is considering with the rationale being that if all other factors are equal between two projects, the one with the highest MIRR is preferable.

Since MIRR is intended to return a single discount rate, the metric is useful only for short-term projections, since the discount rate can vary over time. If cash flow alternates between negative and positive more than once of the project life, there will be multiple project MIRRs with the number of MIRRs equal to the number of times cashflow changes sign. The complexity of the cash-flow model can render the calculation of MIRR meaningless and is not an indication of a flaw in the analysis itself.

Net project investment cost/income: The algebraic sum of the monthly project investment costs (this tabulation is omitted in the above figures in the interest of brevity). The project investment cost for any month is the difference between cumulative expense and cumulative revenue multiplied by the appropriate interest rate. A positive number identifies the total amount that the contractor finances over the life of the project. A negative number indicates that more income is derived from the financing than is expended.

Positive cash flow: The month in which cumulative cash flow becomes positive. This is a coarse metric used to rate the financial attractiveness of a project.