

PART

IV

Managing Cash Flows

In this section we look at how to manage the company's cash flows and how to evaluate different sources of funding its cash needs. This section includes the following chapters:

- ❑ Chapter 12: Cash Flows for Construction Projects
- ❑ Chapter 13: Projecting Income Taxes
- ❑ Chapter 14: Cash Flows for Construction Companies
- ❑ Chapter 15: Time Value of Money
- ❑ Chapter 16: Financing a Company's Financial Needs

Cash Flows for Construction Projects

In this chapter you learn to develop a cash-flow projection for a construction project from both the perspective of a construction company that is receiving progress payments or draws from the project's owner and from the perspective of a construction company that receives a single payment when the project is sold—such as is the case with many homebuilders. For companies in either of these situations, the company must pay for some or all of the construction costs—especially labor—from the company's funds before being reimbursed for these costs. To cover these costs the company needs cash. Because inadequate funding on the part of the construction company can spell doom to a construction project as well as to all of the companies involved, it is important that managers accurately project both the amount and timing of the cash required by a construction project. An understanding of the cash flow for a construction project is a prerequisite to preparing a cash flow for an entire construction company, which is discussed in Chapter 14.

There are two primary threats to a construction company's financial future. The first threat is a lack of profitability. The second threat is insufficient cash. Insufficient cash is where the company lacks sufficient funds to pay the bills that are due. A company may be profitable and still fail because it lacks sufficient cash. In this chapter we look at the cash needed to construct individual projects.

The cash generated by a project is equal to the cash receipts less the cash disbursements. If the cash disbursements are less than the cash receipts for a project, the project will be generating cash for use by the company on other projects, to cover general overhead, or provide a profit to the owners. When a project is generating cash the cash flow will be positive. If the cash disbursements exceed the cash receipts on a project, the company will need to supply cash to fund the project and the cash flow will be negative. Most construction projects require the investment of cash at the beginning of the project and, if they are profitable, generate cash near the end of the project.

With a large portion of a company's financial assets tied up in the form of cash used to fund construction projects, it is important that a construction manager

understands how the decisions he or she makes regarding individual construction projects affect the project's need for cash and as a result the company's cash flow. The construction company's needs for cash stem from the company's need to pay bills before receiving payment from the owner for the work associated with these bills. A lack of sufficient cash hurts a construction company in many ways. First, when a company cannot pay its bills on time because of a lack of cash, the company may have to pay late charges, pay higher prices, or may have to prepay for materials and subcontractor services. When the company pays late charges and higher prices, this reduces a company's profits and reduces a company's ability to compete based on price. When a company has to prepay for materials and services due to lack of cash, this increases its need for cash and further aggravates the problem. Second, the amount of cash a construction company has greatly affects the amount of work the company can perform. This can be in the form of limits placed on a company from the bonding and insurance carriers or because the company cannot acquire the necessary materials and subcontractor services necessary to complete the project because it lacks the cash necessary to obtain credit. If the lack of cash is great enough, an otherwise profitable company may be forced into bankruptcy.

In this chapter we look at the project's cash flow and cash requirements from two perspectives whose cash requirements differ greatly. The first perspective is from the construction company that is receiving a monthly payment from the project's owner. The second perspective is from a construction company that receives a single payment when the project is sold. This perspective is applicable to homebuilders who get paid when the house is sold or construction companies that are developing a property. In both of these cases a company needs to fund the construction until the project is sold or permanent, long-term financing can be obtained for the project.

CASH FLOW FOR PROJECTS WITH PROGRESS PAYMENTS

For construction projects where a construction company receives monthly progress payments the cash flow from the project has three unique characteristics. First, the cash receipts for the project usually occur only once during each month. As a result, there is a single point in time during the month when the cash a construction company has invested in the project rapidly decreases, which coincides with the receipt of the payment from the owner. Second, a construction company can often defer paying some of the costs associated with the construction on these types of projects until it receives payment from the owner. As a result, much of the payment from the owner is immediately paid out to suppliers and subcontractors. In effect, some of the cash associated with these projects quickly passes from the project's owner through the construction company's banking accounts to the suppliers and subcontractors. Third, the owner holds back part of the payments due to the construction company in the

form of retention, which is held until the project is completed. At the completion of the project, the owner pays the construction company the retention. Retention on a project can often exceed the expected profits on a project. These three factors all affect a construction company's need for cash on a project with progress payments.

To determine the needed cash for a project we need to look at the timing of the cash flows for the project; specifically, the cash flows associated with the payments from the owner versus the payment of the construction bills.

One of the biggest factors in determining the cash needs for a project is the schedule of payments from the owner. A construction company will need more cash to complete a project when the owner pays the monthly bill 60 days after receipt of the bill than it would need if the owner paid the monthly bill 15 days after receipt. Often the final payment has a different payment schedule than the progress payments.

Another big factor in determining the cash needs for a construction project is retention. Retention is often held by the owner to ensure that a construction company completes a project. Most commonly, retention is expressed as a percentage of the cost of the work billed to the owner. Common retention rates include 5 and 10%. In some cases, the owner may hold retention only on the first half of the contract. For example, the owner may hold 10% retention until the contract is 50% complete, at which time no additional retention is withheld. In this example, at the completion of the project the owner would be holding retention equal to 5% of the contract amount. The retention is often paid to the construction company at the time of the final payment although it may be paid at a later date. When negotiating a construction contract, the contractor should negotiate the retention terms as well as the contract price.

One of the greatest needs for cash on a project comes from labor performed by the company on the project. Typically, labor for a project is paid weekly or every two weeks. Often, contracts—especially government contracts—require that employees are paid weekly. When paying weekly, the construction company pays for the labor performed for the previous week during the current week. For a construction company that bills the owner on a monthly basis this means that the company will pay up to four weeks of labor before it can bill the owner for the labor and then the construction company has to wait for the owner to pay the bill. If the owner pays one month after the bill is received, the construction company will need enough cash to cover two months of labor. If the payment schedule for the owner is increased to 45 days, the contractor will be funding two and a half months of payroll. Conversely, if the payment terms are reduced to 15 days the contractor will reduce funding needs to one and a half months of payroll. Because retention cannot be held from employees' wages, the construction company also must have sufficient cash to cover the retention held on wages. One way a construction company may reduce the cash required to cover labor costs is to subcontract the labor out, thereby utilizing the subcontractor's cash rather than its own.

Example 12-1: Payroll due to the employees on a project is \$10,594 for the week of May 12 through 18. The employees will be paid on May 21. The construction company can bill the owner for this labor on May 31 and will be paid for the labor on June 25. How long must the construction company fund the labor?

Solution: The company must fund the \$10,594 of labor from May 21 to June 25 or for 35 days.

Another need for cash comes from the use of materials on the project. The payment terms with material suppliers vary from company to company. Material suppliers often require that they be paid without taking into account whether the construction company has received payment from the owner. Commonly, suppliers require that they be paid 10, 15, or 30 days after issuing the bill. How often the supplier bills the construction company has a great effect on the cash needs of the construction company. For example, a project where the owner pays the monthly bills within 15 days of receipt and the suppliers bill monthly—just in time for the construction company to submit the monthly bill to the owner—and the suppliers allow the construction company 30 days to pay the bill, the construction company would not need cash to pay the supplier's bills. This is because the construction company receives payment from the owner before it has to pay the suppliers. Whereas if the supplier on the same project bills on a weekly basis, the construction company would need cash to cover the bills received during the first part of the monthly billing period. Bills received after the middle of the month will not require funding by the construction company. When dealing with large purchases or when the construction company is one of the supplier's largest customers, the construction company may be able to negotiate for the supplier to be paid when the owner pays the construction company. Like subcontracting, this allows the construction company to use the supplier's cash rather than its own. Most often material suppliers will not allow retention to be held from their payments, leaving the construction company to supply the cash needed to cover retention on the materials. Some suppliers offer discounts for early payment. Determining whether a company should take advantage of the discounts is discussed in Chapter 16.

Example 12-2: A \$5,000 material bill for lumber is received on May 7 and is due 30 days from its billing date of May 1. An \$800 material bill for lumber is received on May 27 and is due 30 days from its billing date of May 23. The construction company can bill the owner for these material bills on May 31 and will be paid on June 15. How long must the construction company fund the costs of these material bills?

Solution: The \$5,000 bill must be paid by May 31; therefore, the company must fund the bill from May 31 to June 15 or for 15 days. The \$800 bill must be paid by June 22, after the construction company receives payment from the owner for this bill; therefore, it will not need to fund the payment of this bill.

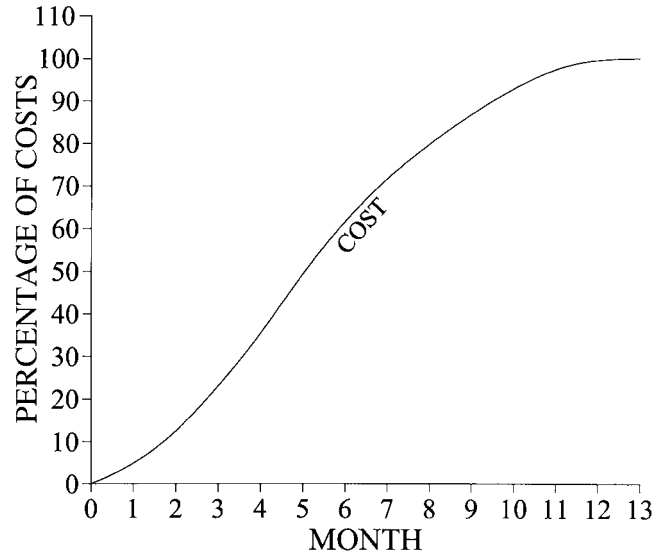
Additional cash may be needed to pay for materials because the point in time when the materials become a billable item to the construction company may be different than the point in time when the materials become a billable item to the project's owner. Materials may become a billable item to the construction company when it orders the materials or when the materials are delivered to the project. The same materials may become a billable item to the project's owner when they are ordered, delivered, or incorporated into the construction project. For example, a supplier of custom-built materials may require that the construction company place a deposit on or prepayment for the materials before fabrication begins. However, the project's owner may require that the materials be incorporated into the project before the construction company can bill the owner for the materials. This would require the construction company to fund the cash paid to the supplier from the time the order was placed until after the materials were incorporated into the project. When dealing with expensive mechanical and electrical equipment, a large sum of cash could be tied up for many months. Similarly, when a project's owner does not pay for materials until they are incorporated into the construction, additional cash is required when materials are delivered to the site before the work crews are ready to incorporate them into the project. When calculating the needed cash for a project, the construction manager should understand when he or she is allowed to bill the project's owner for materials used in the construction project.

Additional cash is needed to cover the cost of the equipment used to construct the project. When equipment is rented on a short-term basis—daily or weekly—the equipment creates the same need for cash as does the materials. When the equipment is leased, the payment of the lease is required on a monthly basis. This requires the construction company to use its cash to cover the cost of the equipment until the owner pays for the work performed by the equipment. When owned equipment is purchased on a loan it behaves much as a lease because there are still monthly payments to make. When the equipment is owned outright the projects that use the equipment are expected to generate a cash flow to cover cash outlays used to purchase equipment; therefore, it behaves much as a lease or purchase with a loan. Many companies set up a separate leasing company for equipment and bill the projects as if the equipment was leased. When setting up a separate leasing company, companies should consult a tax professional to make sure that they understand the tax implications of setting up such a company are understood.

One of the advantages of using subcontractors is that subcontractors are often paid when the contractor gets paid. This allows the contractor to use the subcontractor's cash for the materials, labor, and equipment supplied by the subcontractor rather than using its own cash. The contractor often holds retention from the subcontractor, further reducing the contractor's need for cash.

Other costs must be looked at on a case-by-case basis. For some items, the construction company may have to pay up front, such as for a building permit. Other items, such as mobilization, the contractor may have to pay for and recoup the cost as the equipment is used on the project.

FIGURE 12-1 Cost Curve

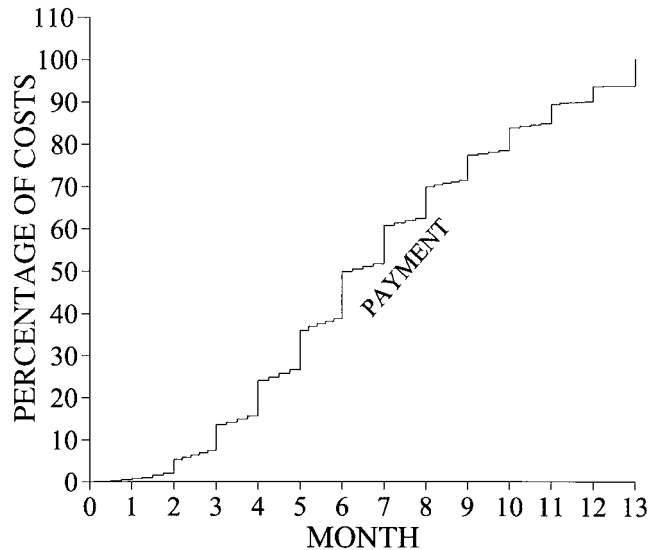


There are four steps a construction manager must follow when developing a cash flow for a construction project.

In the first step, the manager must prepare a cost-loaded schedule for the project. The preparation of a cost-loaded schedule was covered in Chapter 7. The rate of progress on a project usually starts out slowly, picks up speed through the middle of the project, and slows down as the project nears completion. Commonly, the rate of progress at the end of the project is slower than at the beginning of the project. A graph showing the cost-loaded schedule for a typical project is shown in Figure 12-1. The graph is based on the cost of the work performed. The months shown on the x axis of the graph represent the end of the months. This cost curve is often referred to as the S curve.

In the second step, the manager must determine when the construction company will pay for the items in the cost-loaded schedule. To do this, the costs on the cost-loaded schedule must be grouped based on their payment terms. For example, labor costs that will be paid during the week following the week the costs were incurred need to be separated from the costs that will be paid when payment is received from the project's owner. Additionally, costs that will be paid in full need to be separated from those costs that retention can be withheld from until the completion of the project, usually subcontractor costs. A graph showing the payment of costs for a project is shown in Figure 12-2. The graph is based on 25% of the costs being materials, 25% being labor, and 50% being subcontractors. The material bills are paid in full when payment is received from the project's owner. The labor is paid weekly. The subcontractors are paid when payment is received, less 10% retention that is withheld until the retention is released by the owner.

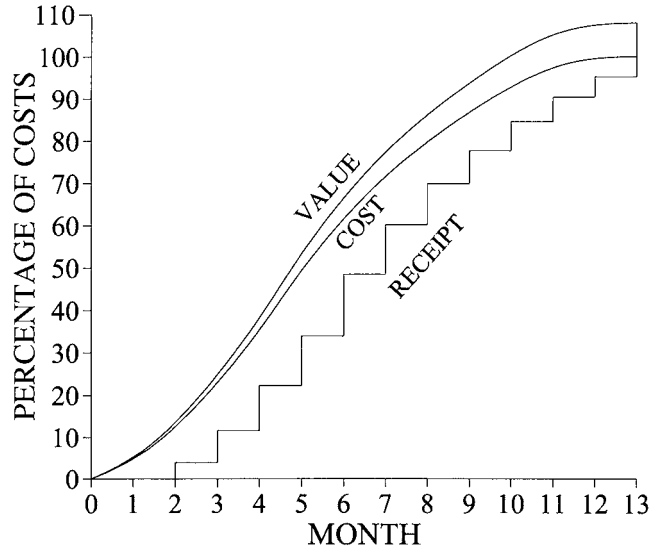
FIGURE 12-2 Payment Curve



In the third step, the manager must determine when payment will be received from the project's owner for the work in the cost-loaded schedule. This is done by determining when the costs in the cost-loaded schedule will be billed to the owner and then determining when payment will be received. The payments must be reduced by the retention withheld by the project's owner and the release of retention must be included in the cash flows at the end of the project. The costs and payments shown in Figures 12-1 and 12-2 include the only the construction costs, while excluding the profit and overhead markup. When billing the project's owner the profit and overhead markup is included in the progress payments. In addition to the cost of the work, Figure 12-3 shows the value of the work, which includes an 8% profit and overhead markup along with the cash receipts (payments) from the project's owner, both of which are expressed as a percentage of costs. The receipts are based on the owner being billed at the end of the month for the work being performed during the month and the project's owner paying the bills at the end of the following month, while withholding a 10% retention. In this example, the costs incurred during the first month are billed at the end of the first month and payment is received from the owner for these costs at the end of the second month. The retention is released at the end of the thirteenth month. If the project's owner paid the bills 15 days after receipt, the receipt curve would move one-half of a month to the left. If payments were received 45 days after receipt of the bill, the receipt curve would move one-half of a month to the right.

In the final step, the manager must determine the difference between the cash inflows to the project (receipts from the owner) and the cash outflows from the project (payment to labor, suppliers, and subcontractors). The vertical distance

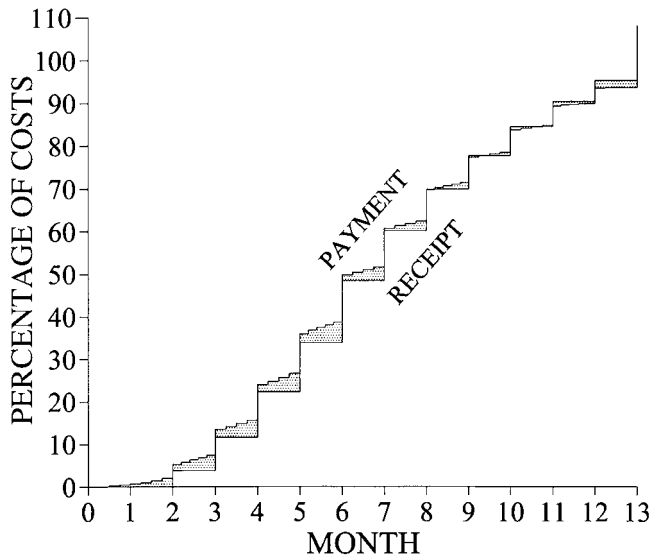
FIGURE 12-3 Receipt Curve



between the payment and receipt lines represents the cash provided by the construction company and is shown as the shaded area in Figure 12-4. In this example, the project first experiences a cash surplus during the tenth month—which is eliminated by labor payments during the month—and by the twelfth month a constant cash surplus on the project occurs.

The cash is provided in the form of actual cash used to cover the costs of the work and the deferral of the profit and overhead markup on part of the con-

FIGURE 12-4 Cash Provided by Construction Company



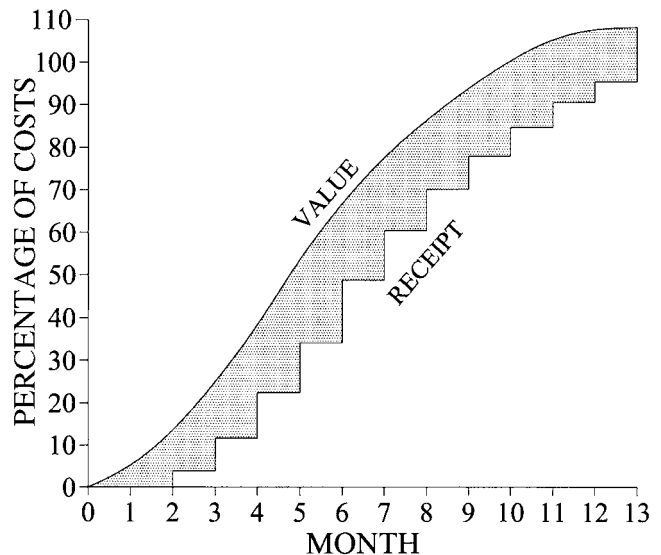
struction company. The profit and overhead markup needs to be included as part of the cash provided for the project for three reasons. First, the profit and overhead markup is needed to cover the costs of the general overhead. If the profit and overhead markup were not paid until the end of the project, the construction company would still need to supply cash to cover the project’s portion of the general overhead costs until the payment of the profit and overhead markup. Second, the profit and overhead markup provides the company with profit that is invested in other company operations or distributed to company’s owners. When payment of the profit and overhead markup is deferred, the company is—by default—investing in the project while forgoing investing in other company operations or distributing the profit to the company’s owners. Third, because many construction companies use the percentage-of-completion accounting method for tax purposes, the company is recording the profits and paying income taxes on those profits throughout the project, even when the profits have not been paid.

The cash provided consists of two components. First, it consists of costs that have been incurred and billed to the owner for which payment has not been received. For the construction company, this is their accounts receivable. Second, it consists of costs incurred during the current billing period that have not been billed to the owner.

The vertical distance between the value and the receipt lines represents the cash provided by the construction company, labor, the suppliers, and the subcontractors and is shown as the shaded area in Figure 12-5.

There are three conclusions that can be made about the amount of cash provided by the construction company. First, during each month the greatest need for cash occurs just prior to receipt of the payment from the owner. From Figure 12-4 we see that when payments are received there is a quick drop in the

FIGURE 12-5 Cash Provided by Construction Company, Labor, Suppliers, and Subcontractors



amount of cash needed. As a result, the cash needed at the end of the month is often less than the peak amount of cash needed during the month. Second, the amount of cash tied up in retention increases as the project is completed. In the above example the cash needed to fund the retention starts out at 0% of the total value of the project and increases to 10% of the total value of the project by the twelfth month. Third, the amount of cash needed—excluding retention—is greatest when the rate of progress is greatest. In other words, the faster the construction company completes the project the more cash it needs.

The monthly cash flow may be characterized by measuring the monthly cash flows to date at two points in time during the month. The first point in time is at the end of each month. This is referred to as the monthly cash flow. The second point in time is when the project requires the greatest investment of cash during the month, which usually occurs just before the payment is received from the project's owner. This is referred to as the peak cash flow and represents the most negative cash flow during the month. Cash flows measured at this point in time are designated by the prime mark, as in n' . These two monthly cash flows are used in Chapter 14 to get a picture of the financial status of the construction company. If we were to look only at the cash flow or cash invested at the end of the month, we would greatly understate the cash needs for many projects.

The monthly cash flow for the project for a specific month equals the cash receipts less the cash disbursements for the month and is calculated as follows:

$$\text{Cash Flow}_n = \text{Cash Receipts}_n - \text{Cash Disbursements}_n \quad (12-1)$$

The peak cash flow for a month—which usually occurs just prior to receipt of payment from the project's owner—is calculated by using Eq. (12-1), where only the cash disbursements included are those that occur prior to receipt of the payment from the owner. The cash receipts would be zero at this point in time.

The total cash generated by a project at a specified date may be measured at the end of each month and at the point in time when the monthly peak cash flow occurs. The total cash generated is calculated by summing all of the cash flows that have occurred prior to the specified date. A negative number represents an investment of cash in the project. The total cash generated as of the end of any month is calculated by summing the monthly cash flows through the end of the month. For example, if we were calculating the total cash generated as of the end of the month of June we would sum the monthly cash flows for all prior months and add the monthly cash flow for June to this sum. Alternately, we could calculate the total cash generated as of the end of the month of June by adding June's monthly cash flow to the total cash generated as of the end of the month of May—the previous month. The cash flow generated is calculated as follows:

$$\text{Cash}_n = \text{Cash}_{n-1} + \text{Cash Flow}_n \quad (12-2)$$

The peak amount of cash required by projects often occurs just prior to receipt of payment from the project's owner. When calculating the total cash generated ($\text{Cash}_{n'}$) just prior to receipt of payment from the project's owner, we would add this month's cash flows ($\text{Cash Flow}_{n'}$) that occur before payment is

received from the owner to the total cash generated as of the end of the previous month. The total cash generated just prior to receipt of payment from the project's owner is calculated as follows:

$$\text{Cash}_{n'} = \text{Cash}_{n-1} + \text{Cash Flow}_{n'} \quad (12-3)$$

Estimating the cash flows and cash generated is shown in the following example. In this example, the cash flows are prepared on a monthly basis. With a little more effort, the example could be solved by preparing the cash flows on a weekly basis.

Example 12-3: A construction company is negotiating on a construction project with a six-month duration. On the last day of each month the construction company may bill the owner for the work completed during the month. The owner pays the monthly bills one month after they are received. For example, the construction company receives payment for work completed during June on July 31. The owner also holds 10% retention. Final payment is expected one month after completion of the project and will include payment of the retention. The construction company pays material suppliers in full when it receives payment from the owner. The construction company pays subcontractors when it receives payment from the owner but withholds 10% from the subcontractor's payment. The construction company pays for labor weekly. The projected monthly material, labor, and subcontractor costs, as well as the amount the construction company will bill the project's owner each month, are shown in Table 12-1. Determine the monthly cash flows and the total cash generated by the project at the end of each month and just before each payment is received from the project's owner. What is the maximum amount of cash invested by the company during the completion of the project?

Solution: To analyze the cash needs of this project we begin at the beginning of the project and work our way to the end of the project, calculating the cash flow and total cash generated at the end of each month and just before each payment is received from the project's owner.

TABLE 12-1 Monthly Costs and Billings for Example 12-3

MONTH	COSTS			BILL TO OWNER (\$)
	MATERIALS (\$)	LABOR (\$)	SUB. (\$)	
1	30,400	34,900	54,700	129,600
2	57,300	48,900	123,800	248,400
3	80,500	73,100	136,400	313,200
4	29,200	34,000	106,800	183,600
5	27,800	26,200	66,000	129,600
6	15,400	11,300	43,300	75,600
Total	240,600	228,400	531,000	1,080,000

Because the first payment from the owner is not received until the second month, the first point in time where we calculate the total cash generated by the project is at the end of the first month. For the first month, the peak cash flow occurs at the end of the month. Because material suppliers and subcontractors are paid only when the construction company receives payment from the owner, no material or subcontractor payments are made during the first month. Payments are made to labor during the month. To simplify calculations we assume that all labor is paid during the month the work is performed although some of the costs may be paid during the first week of the following month. At the end of the first month the construction company has paid \$34,900 to cover the cost of the labor. The cash flow for the first month is calculated using Eq. (12-1) as follows:

$$\begin{aligned}\text{Cash Flow}_n &= \text{Cash Receipts}_n - \text{Cash Disbursements}_n \\ \text{Cash Flow}_n &= \text{Cash Receipts}_n - (\text{Material Payments}_n \\ &\quad + \text{Labor Payments}_n + \text{Subcontractor Payments}_n) \\ \text{Cash Flow}_1 &= \$0 - (\$0 + \$34,900 + \$0) = -\$34,900\end{aligned}$$

The total cash generated by the project by the end of the first month is calculated using eq. (12-2) as follows:

$$\begin{aligned}\text{Cash}_1 &= \text{Cash}_0 + \text{Cash Flow}_1 \\ \text{Cash}_1 &= \$0 + (-\$34,900) = -\$34,900\end{aligned}$$

At the end of the first month the construction company will have \$34,900 of cash invested in the project.

The next point in time where we need to calculate total cash generated by the project is just before receipt of the first payment from the owner, which occurs at the end of the second month. No additional payments have been made to suppliers and subcontractors during this part of the month. The construction company has paid out \$48,900 to cover the cost of the labor performed during the second month. This cash flow is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_{2'} = \$0 - (\$0 + \$48,900 + \$0) = -\$48,900$$

The total cash generated by the project just before the first payment is received from the project's owner is calculated using Eq. (12-3) as follows:

$$\begin{aligned}\text{Cash}_{2'} &= \text{Cash}_1 + \text{Cash Flow}_{2'} \\ \text{Cash}_{2'} &= -\$34,900 + (-\$48,900) = -\$83,800\end{aligned}$$

Just before the construction company receives payment from the owner during the second month, the construction company will have \$83,800 of cash invested in the project.

At the end of the second month the construction company will have received the first payment from the owner. The payment will be equal to the

work billed at the end of the first month less the 10% retention. The payment received from the owner during the second month is calculated as follows:

$$\begin{aligned} \text{Cash Receipt}_n &= \text{Bill}_{n-1}(1 - \text{Retention Rate}) \\ \text{Cash Receipt}_2 &= \$129,600(1 - 0.10) = \$116,640 \end{aligned}$$

During the month the construction company will have paid out \$30,400 to material suppliers, \$48,900 to cover the cost of the labor, and the first month’s subcontractor costs—less the 10% retention. The subcontractor payments for the second month are as follows:

$$\text{Subcontractor Payments}_2 = \$54,700(0.90) = \$49,230$$

The cash flow for the second month is calculated using Eq. (12-1) as follows:

$$\begin{aligned} \text{Cash Flow}_2 &= \$116,640 - (\$30,400 + \$48,900 + \$49,230) \\ \text{Cash Flow}_2 &= -\$11,890 \end{aligned}$$

The total cash generated by the project by the end of the second month is calculated using Eq. (12-2) as follows:

$$\text{Cash}_2 = -\$34,900 + (-\$11,890) = -\$46,790$$

The maximum amount of cash needed during the second month is \$37,010 (\$83,800 – \$46,790) more than the amount of cash needed at the end of the month.

The cash flows and the amount of cash needed for the third through the sixth month are calculated in a similar manner and are shown in Table 12-2.

The next point in time where we need to calculate total cash generated by the project is just before receipt of the last payment from the owner, which occurs at the end of the seventh month. By this time the construction company has not paid any additional costs; therefore, the total cash generated by the project equals the total cash generated by the project at the end of the previous month for a total of \$11,430.

The payment received from the owner during the seventh month will include the full amount of the bill from the sixth month plus the retention

TABLE 12-2 Monthly Cash Flow and Cash Invested for Example 12-3

MONTH	MONTHLY CASH FLOW (\$)		CASH GENERATED (\$)	
	<i>n'</i>	<i>n</i>	<i>n'</i>	<i>n</i>
1	-34,900	-34,900	-34,900	-34,900
2	-48,900	-11,890	-83,800	-46,790
3	-73,100	-18,260	-119,890	-65,050
4	-34,000	44,620	-99,050	-20,430
5	-26,200	13,720	-46,630	-6,710
6	-11,300	18,140	-18,010	11,430
7	0	68,570	11,430	80,000

withheld from the previous months. The retention held during the first six months is as follows:

$$\begin{aligned}\text{Retention} &= \$0 + \$129,600(0.10) + \$248,400(0.10) \\ &\quad + \$313,200(0.10) + \$183,600(0.10) + \$129,600(0.10) \\ \text{Retention} &= \$100,440\end{aligned}$$

The seventh month's payment from the owner is as follows:

$$\text{Cash Receipt}_7 = \$100,440 + \$75,600 = \$176,040$$

During the month the construction company will have paid out \$15,400 to material suppliers and will have to pay for the sixth month's subcontractor costs plus all of the retention held during the first six months. The retention held from the subcontractor payments during the first six months is as follows:

$$\begin{aligned}\text{Retention} &= \$0 + \$54,700(0.10) + \$123,800(0.10) \\ &\quad + \$136,400(0.10) + \$106,800(0.10) + \$66,000(0.10) \\ \text{Retention} &= \$48,770\end{aligned}$$

The seventh month's payment to the subcontractors is as follows:

$$\text{Subcontractor Payments}_7 = \$48,770 + \$43,300 = \$92,070$$

The cash flow for the seventh month is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_7 = \$176,040 - (\$15,400 + \$0 + \$92,070) = \$68,570$$

The total cash generated by the project at the end of the seventh month is calculated using Eq. (12-2) as follows:

$$\text{Cash}_7 = \$11,430 + \$68,570 = \$80,000$$

At this point the project is complete. At the completion of the project the cash generated by the project should equal the profit and overhead realized on the project, which equals the profit and overhead markup for this example. The monthly cash flow and the cash generated at the end of each month are shown in Table 12-2. The cash generated by the project just before payment from the owner and at the end of the month are shown in Figure 12-6.

The maximum amount of cash invested in the project by the construction company occurs in the third month and is \$119,890, which is greater than the profit and overhead markup on the project. For the construction company to complete this project, it would need about \$120,000 in cash.

Example 12-3 may be solved using a spreadsheet. The spreadsheet solution for Example 12-3 is found in Figure 12-7.

From the previous example we see that the cash requirements just before payment was received from the project's owner were consistently greater than the cash requirements at the end of the month. Had we projected the amount of cash

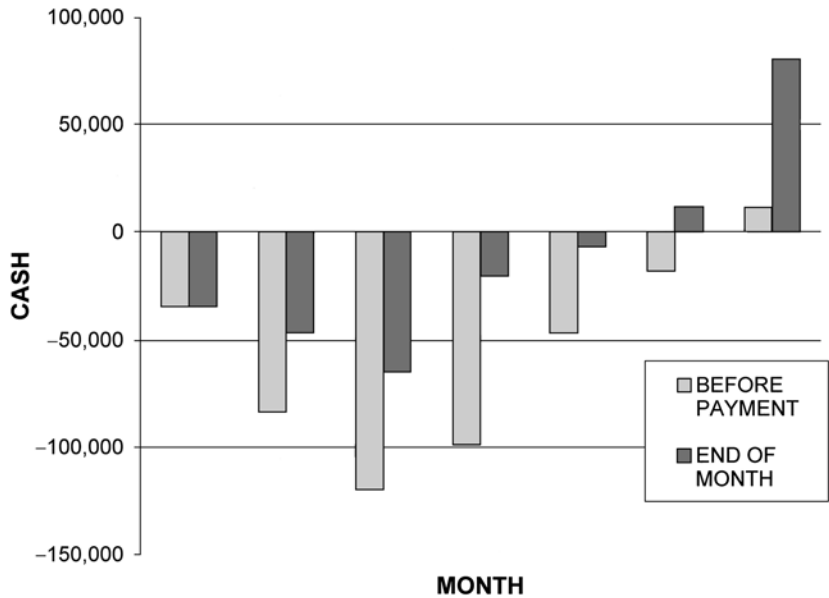


FIGURE 12-6 Cash Generated by the Project in Example 12-3

Retention Rate: 10%							
Month	1	2	3	4	5	6	7
Bill to Owner	129,600	248,400	313,200	183,600	129,600	75,600	—
Materials	30,400	57,300	80,500	29,200	27,800	15,400	—
Labor	34,900	48,900	73,100	34,000	26,200	11,300	—
Subcontractor	54,700	123,800	136,400	106,800	66,000	43,300	—
Total Costs	120,000	230,000	290,000	170,000	120,000	70,000	—
P&O	9,600	18,400	23,200	13,600	9,600	5,600	—
Receipts	—	116,640	223,560	281,880	165,240	116,640	176,040
Payments							
Materials	—	30,400	57,300	80,500	29,200	27,800	15,400
Labor	34,900	48,900	73,100	34,000	26,200	11,300	—
Subcontractor	—	49,230	111,420	122,760	96,120	59,400	92,070
Total Payments	34,900	128,530	241,820	237,260	151,520	98,500	107,470
Cash Flow Before Payment		(48,900)	(73,100)	(34,000)	(26,200)	(11,300)	—
Total Cash Before Payment		(83,800)	(119,890)	(99,050)	(46,630)	(18,010)	11,430
Cash Flow at Month's End	(34,900)	(11,890)	(18,260)	44,620	13,720	18,140	68,570
Total Cash at Month's End	(34,900)	(46,790)	(65,050)	(20,430)	(6,710)	11,430	80,000

FIGURE 12-7 Spreadsheet Solution for Example 12-3

SIDEBAR 12 - 1

CALCULATING A PROJECT'S CASH FLOW USING EXCEL

Figure 12-7 may be set up in a spreadsheet as shown in the following figure:

	A	B	C	G	H
1	Retention Rate:	10%			
2					
3	Month	1	2	6	7
4	Bill to Owner	129,600	248,400	75,600	-
5					
6	Materials	30,400	57,300	15,400	-
7	Labor	34,900	48,900	11,300	-
8	Subcontractor	54,700	123,800	43,300	-
9	Total Costs	120,000	230,000	70,000	-
10					
11	P&O	9,600	18,400	5,600	-
12					
13	Receipts	-	116,640	116,640	176,040
14					
15	Payments				
16	Materials	-	30,400	27,800	15,400
17	Labor	34,900	48,900	11,300	-
18	Subcontractor	-	49,230	59,400	92,070
19	Total Payments	34,900	128,530	98,500	107,470
20					
21	Cash Flow Before Payment		(48,900)	(11,300)	-
22					
23	Total Cash Before Payment		(83,800)	(18,010)	11,430
24					
25	Cash Flow at Month's End	(34,900)	(11,890)	18,140	68,570
26					
27	Total Cash at Month's End	(34,900)	(46,790)	11,430	80,000

To set up this spreadsheet, the formulas, text, and values shown on page 275 need to be entered into it.

The equations for the third through fifth months can be copied from the second month. The amount of the final payment from the owner (receipt) and payments to the suppliers, labors, and subcontractors is the unpaid balance for each of these items. For the revenues, this is calculated by summing the bills to the owner and subtracting the sum of payment made in the previous months. The costs are handled in a similar manner.

	A	B	C	G	H
1	Retention Rate:	0.1			
2					
3	Month	1	2	6	7
4	Bill to Owner	129600	248400	75600	0
5					
6	Materials	30400	57300	15400	0
7	Labor	34900	48900	11300	0
8	Subcontractor	54700	123800	43300	0
9	Total Costs	=SUM(B6:B8)	=SUM(C6:C8)	=SUM(G6:G8)	=SUM(H6:H8)
10					
11	P&O	=B4-B9	=C4-C9	=G4-G9	=H4-H9
12					
13	Receipts	0	=B4*(1-\$B\$1)	=F4*(1-\$B\$1)	=SUM(B4:H4)-SUM(B13:G13)
14					
15	Payments				
16	Materials	0	=B6	=F6	=SUM(B6:G6)-SUM(B16:G16)
17	Labor	=B7	=C7	=G7	=SUM(B7:G7)-SUM(B17:G17)
18	Subcontractor	0	=B8*(1-\$B\$1)	=F8*(1-\$B\$1)	=SUM(B8:G8)-SUM(B18:G18)
19	Total Payments	=SUM(B16:B18)	=SUM(C16:C18)	=SUM(G16:G18)	=SUM(H16:H18)
20					
21	Cash Flow Before Payment		=-C7	=-G7	=-H7
22					
23	Total Cash Before Payment		=B27+C21	=F27+G21	=G27+H21
24					
25	Cash Flow at Month's End	=B13-B19	=C13-C19	=G13-G19	=H13-H19
26					
27	Total Cash at Month's End	=B25	=C25+B27	=G25+F27	=H25+G27

needed to complete the project based on the cash needed at the end of the months we would have come up short by as much as \$78,620.

In the previous example there were five things that affected the amount of cash needed to complete the project. They are material payments, labor payments, subcontractor payments, retention held by the owner, and the profit and overhead markup. Let's look at how each of these affects the project's cash requirements. Retention will be dealt with separately rather than lumped in with material payments, labor payments, and subcontractor payments so that we can see the effects of retention.

Material payments did not affect the project's cash requirements because the material bills were paid in full when the company received payment from the owner.

Labor payments had a great effect on the project's cash requirements. Just before receiving the payment from the owner, the construction company had paid out almost two months of wages. For the labor performed during the first month the construction company will pay the wages during the first month, bill the owner for the wages at the end of the first month, and receive payment from the owner at the end of the second month. During this time the owner will have to cover the costs of the wages for the second month. The maximum amount of cash needed to cover the costs of labor during the project occurs in the third month. At this time the construction company has to cover the second and third month's wages for a total of \$122,000.

Subcontractor payments were paid when the company received payment from the owner; however, the payment was reduced by the 10% retention. As a result, the subcontractors became a source of cash that offsets the cash consumed by retention held by the owners. By the seventh month, the subcontractors had provided \$48,770 of cash to the construction company, which is the amount of retention withheld from the subcontractors during the first six months.

Retention is an extensive use of cash. By the seventh month the owner had withheld \$100,400 in retention from the contractor.

Profit and overhead markup was a source of cash. By the end of the project it provided the company with \$80,000 in cash. However, this cash is needed to cover the costs of the general overhead, provide cash for investment, and provide a profit to the company's shareholders.

In the previous example there are four ways the construction company could reduce the project's cash requirements. First, the construction company could increase its use of subcontractors as a way to reduce the materials and labor that it provides. By using subcontractors in lieu of in-house labor, the construction company uses the subcontractor's cash to cover the cost of labor and increases its cash by withholding retention from the subcontractors on the labor supplied. By having the subcontractors provide materials, the construction company increases its cash by withholding retention from the subcontractors on the materials supplied. Second, the construction company could negotiate a more favorable retention rate. The greatest benefit of reducing the retention rate comes

when the construction company is providing most of the labor and materials, while minimizing the use of subcontractors. When subcontractors are supplying most of the labor and materials and the construction company is withholding retention on the subcontractors, there is little benefit gained by reducing the retention rate because the construction company passes the lower retention rate on to its subcontractors. The savings in cash due to the reduced retention rate is offset by a loss of cash being provided by the subcontractors in the form of retention. Third, the construction company could increase the profit and overhead markup. Increasing the profit and overhead markup raises the entire receipt curve in Figure 12-4. This decreases the distance between the payment and receipt curves when the payments (outgoing cash) are greater than the receipts (incoming cash), which reduces the cash needed for the project. Fourth, the schedule of values can be front loaded by increasing the price charged to the owner for items completed early in the project while decreasing the price of items completed later in the project. The price increases and decreases are such that the total cost of the project remains unchanged. Front loading the project raises the early portions of the receipt curve, the portions where a company has the most cash invested in the project, while leaving the later part of the curve unchanged. This decreases the distance between the payment and receipt curves for the early part of the project, which reduces the amount of cash needed for the project. Let's look at how subcontractors affect the amount of cash needed for a project.

Example 12-4: How would the project's cash requirements change for the construction company in Example 12-3 if it increased the amount of work performed by subcontractors from 53.1 to 74.1% as shown in Table 12-3?

Solution: This example may be solved in the same manner that Example 12-3 was solved. The monthly cash flow and the cash generated at the end of each month for this example are shown in Table 12-4.

TABLE 12-3 Monthly Costs and Billings for Example 12-4

MONTH	COSTS			BILL TO OWNER (\$)
	MATERIALS (\$)	LABOR (\$)	SUB. (\$)	
1	17,700	19,000	83,300	129,600
2	31,600	26,300	172,100	248,400
3	47,700	40,100	202,200	313,200
4	15,500	17,800	136,700	183,600
5	14,200	14,600	91,200	129,600
6	8,300	6,300	55,400	75,600
Total	135,000	124,100	740,900	1,080,000

TABLE 12-4 Monthly Cash Flow and Cash Invested for Example 12-4

MONTH	MONTHLY CASH FLOW (\$)		CASH GENERATED (\$)	
	<i>n'</i>	<i>n</i>	<i>n'</i>	<i>n</i>
1	-19,000	-19,000	-19,000	-19,000
2	-26,300	-2,330	-45,300	-21,330
3	-40,100	-3,030	-61,430	-24,360
4	-17,800	34,400	-42,160	10,040
5	-14,600	12,110	-4,560	22,150
6	-6,300	14,060	15,850	36,210
7	0	43,790	36,210	80,000

A comparison of the maximum cash invested in the project for each of the months for Examples 12-3 and 12-4 is shown in Figure 12-8. A comparison of the cash invested at the end of each of the months for Examples 12-3 and 12-4 is shown in Figure 12-9.

At the completion of the project the cash generated by both examples equals the profit and overhead markup. The peak amount of cash invested in the project by the construction company occurs in the third month and is \$61,430 for Example 12-4 compared to the \$119,890 that was required by Example 12-3. Example 12-4 required less cash investment and required this investment for a shorter period of time than did Example 12-3. This is because the construction company used the subcontractor's cash rather than its own to fund the project.

FIGURE 12-8 Maximum Cash Invested for Examples 12-3 and 12-4

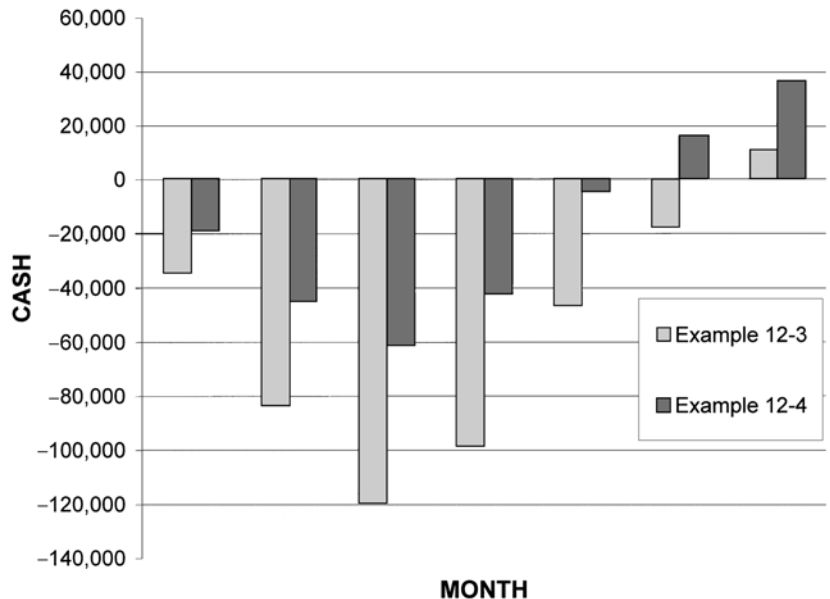
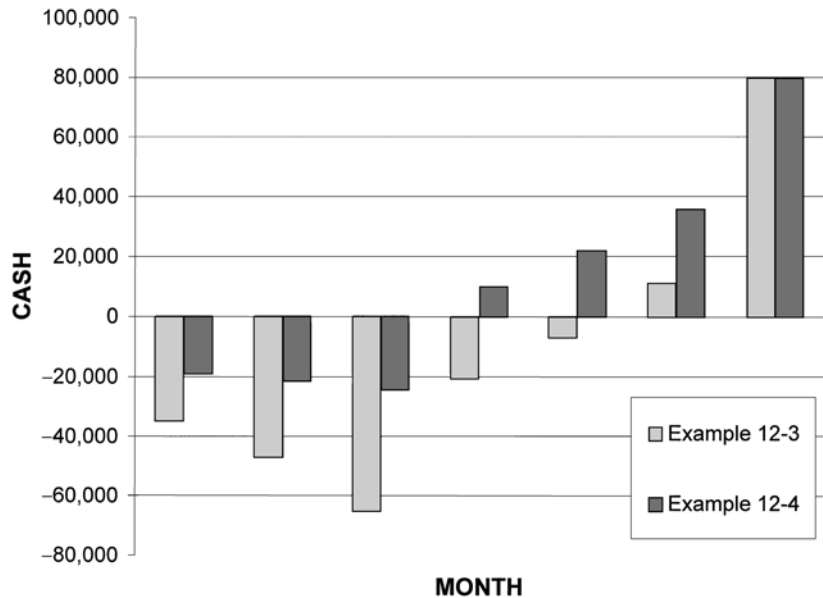


FIGURE 12-9 Cash Invested at the End of Each Month for Examples 12-3 and 12-4



In Examples 12-3 and 12-4 we looked at the amount of cash a construction company needs to complete a project. In both of these examples the owner of the project received the benefit of using the construction company and its suppliers and subcontractor’s cash rather than using his or her own cash. The benefit to the project’s owner equals the amount of cash provided by the construction company, the labor, the suppliers, and the subcontractors, which equals the cost to the owner for the work performed (the value curve in Figure 12-5) less the payments received from the owner. The benefit for a specific month is calculated by taking the previous month’s benefit and adding this month’s costs less this month’s receipts and may be written as follows:

$$\text{Cash}_n = \text{Cash}_{n-1} + \text{Bills}_n - \text{Receipt}_n \tag{12-4}$$

Like the cash required by the construction company, the benefit to the owner may be measured just before the monthly payment to the construction company is made and at the end of the month. Now let’s look at the benefit the owner receives from this.

Example 12-5: Determine the amount of cash that the construction company and its suppliers and subcontractors are providing to the project owner in Example 12-3.

Solution: We start at the beginning of the project and work our way to the end of the project, calculating the benefit to the owner at the end of each month and just before payment is made to the construction company.

Because the owner does not make a payment during the first month, the first point in time we calculate the benefit is at the end of the first month. From Example 12-3 the monthly bill to the owner is \$129,600 and the monthly benefit is calculated using Eq. (12-4) as follows:

$$\begin{aligned}\text{Cash}_n &= \text{Cash}_{n-1} + \text{Bills}_n - \text{Receipt}_n \\ \text{Cash}_1 &= \$0 + \$129,600 - \$0 = \$129,600\end{aligned}$$

At the end of the first month the construction company and its suppliers and subcontractors have provided the project's owner with \$129,600 in funding for the project.

The next point in time we need to calculate the benefit to the owner is just before receipt of the first payment from the owner, which occurs at the end of the second month. The benefit just before the payment has been received is equal to the cash from the previous month plus the cost of the work completed between the end of the previous month and just before receipt of payment from the owner. The cost of the work completed between the end of the previous month and just before receipt of payment from the owner is approximately equal to the billing to the owner. The benefit is calculated using Eq. (12-4) as follows:

$$\text{Cash}_{1'} = \$129,600 + \$248,400 - 0 = \$378,000$$

The benefit for the end of the second month is calculated as follows:

$$\text{Cash}_2 = \$129,600 + \$248,400 - \$116,640 = \$261,360$$

The benefits for the third through seventh months are calculated as follows:

$$\begin{aligned}\text{Cash}_{3'} &= \$261,360 + \$313,200 - \$0 = \$574,560 \\ \text{Cash}_3 &= \$261,360 + \$313,200 - \$223,560 = \$351,000 \\ \text{Cash}_{4'} &= \$351,000 + \$183,600 - \$0 = \$534,600 \\ \text{Cash}_4 &= \$351,000 + \$183,600 - \$281,880 = \$252,720 \\ \text{Cash}_{5'} &= \$252,720 + \$129,600 - \$0 = \$382,320 \\ \text{Cash}_5 &= \$252,720 + \$129,600 - \$165,240 = \$217,080 \\ \text{Cash}_{6'} &= \$217,080 + \$75,600 - \$0 = \$292,680 \\ \text{Cash}_6 &= \$217,080 + \$75,600 - \$116,640 = \$176,040 \\ \text{Cash}_{7'} &= \$176,040 + \$0 - \$0 = \$176,040 \\ \text{Cash}_7 &= \$176,040 + \$0 - \$176,040 = \$0\end{aligned}$$

As expected, when the owner has paid for the project in full, the benefit provided by the construction company and its suppliers and subcontractors is zero. The maximum benefit provided by the construction company and its suppliers and subcontractors occurs during the third month and has a value in excess of half of the total cost of the project to the owner. In other words, during the third month the construction company and its suppliers and subcontractors are providing over half of the funds needed to construct the project.

Sometimes a project will receive progress payment from the project’s owner at intervals other than monthly. For example, a project may receive progress payments at 25, 50, 75, and 100% complete. The procedures for calculating the project’s cash needs are the same as for a project that receives monthly payments, with cash flows being calculated at the end of each month and just before each payment is received.

Let’s look at a specialized cash flow that works for projects with multiple buildings of the same design. This type of cash flow often occurs when constructing office condominiums, warehouse complexes, residential condominiums, and residences where the construction contractor gets paid monthly, as is the case for many subcontractors. This type of cash flow is estimated by calculating a cash flow for each building type and then combining these cash flow projections with an estimated number of building starts for each month.

Example 12-6: A construction company is bidding on a contract to build homes for a developer. The project consists of two types of homes and is scheduled to begin in June. The first payment from the owner will occur in July. The expected monthly homes starts are shown in Table 12-5. The cash flow that occurs between the end of the previous month and receipt of payment from the owner along with the cash flow for the entire month is shown in Table 12-6. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before each payment is received from the project’s owner for the remaining months in the year. What is the maximum amount of cash invested by the company during the remaining months of the year?

TABLE 12-5 Monthly Starts by Type

MONTH	TYPE 1	TYPE 2
June	1	2
July	2	1
Aug.	1	3
Sept.	3	1
Oct.	1	2
Nov.	2	2
Dec.	2	2

TABLE 12-6 Cash Flow by Type

MONTH	BEFORE PAYMENT IS RECEIVED (<i>n'</i>) (\$)		END OF MONTH (<i>n</i>) (\$)	
	TYPE 1	TYPE 2	TYPE 1	TYPE 2
1	-5,800	-6,700	-5,800	-6,700
2	-8,400	-9,500	-1,900	-2,500
3	-17,100	-20,200	7,500	9,700
4	-4,800	-4,800	2,300	3,000
5	-2,100	-1,900	3,100	3,600
6	0	0	10,500	12,800

Solution: As in the past problems, we begin our calculations in the first month—June—and work our way to the last month—December. Because the owner does not make a payment in June the first point in time we need to calculate the cash flow is at the end of June. The cash flow for June includes only the first month's cash flows for the June housing starts and is calculated as follows:

$$\begin{aligned}\text{Cash Flow}_{\text{June}} &= \text{Type I Starts}_{\text{June}}(\text{Type I Cash Flow}_1) \\ &\quad + \text{Type II Starts}_{\text{June}}(\text{Type II Cash Flow}_1) \\ \text{Cash Flow}_{\text{June}} &= 1(-\$5,800) + 2(-\$6,700) = -\$19,200\end{aligned}$$

The total cash invested at the end of the month of June is calculated using Eq. (12-2) as follows:

$$\text{Cash}_{\text{June}} = \$0 + (-\$19,200) = -\$19,200$$

The next point in time we calculate the cash flow is just before the payment is received in July. The cash flows for July includes the second month's cash flows (from the end of the previous month to the time the payment is received) for the June housing starts and the first month's cash flows (from the end of the previous month to the time the payment is received) for the July housing starts. This cash flow is calculated as follows:

$$\begin{aligned}\text{Cash Flow}_{\text{July}'} &= \text{Type I Starts}_{\text{June}}(\text{Type I Cash Flow}_{2'}) \\ &\quad + \text{Type II Starts}_{\text{June}}(\text{Type II Cash Flow}_{2'}) \\ &\quad + \text{Type I Stats}_{\text{July}}(\text{Type I Cash Flow}_{1'}) \\ &\quad + \text{Type II Stats}_{\text{July}}(\text{Type II Cash Flow}_{1'}) \\ \text{Cash Flow}_{\text{July}'} &= 1(-\$8,400) + 2(-\$9,500) + 2(-\$5,800) \\ &\quad + 1(-\$6,700) \\ \text{Cash Flow}_{\text{July}'} &= -45,700\end{aligned}$$

The total cash invested just prior to the July payment is calculated using Eq. (12-3) as follows:

$$\text{Cash}_{\text{July}'} = -\$19,200 + (-\$45,700) = -\$64,900$$

The next point in time we calculate the cash flow is at the end of July, which is calculated using the end of month cash flows as follows:

$$\begin{aligned}\text{Cash Flow}_{\text{July}'} &= \text{Type I Starts}_{\text{June}}(\text{Type I Cash Flow}_2) \\ &\quad + \text{Type II Starts}_{\text{June}}(\text{Type II Cash Flow}_2) \\ &\quad + \text{Type I Stats}_{\text{July}}(\text{Type I Cash Flow}_1) \\ &\quad + \text{Type II Stats}_{\text{July}}(\text{Type II Cash Flow}_1) \\ \text{Cash Flow}_{\text{July}'} &= 1(-\$1,900) + 2(-\$2,500) + 2(-\$5,800) \\ &\quad + 1(-\$6,700) \\ \text{Cash Flow}_{\text{July}'} &= -25,200\end{aligned}$$

The total cash invested at the end of July is calculated using Eq. (12-2) as follows:

$$\text{Cash}_{\text{July}} = -\$19,200 + (-\$25,200) = -\$44,400$$

TABLE 12-7 Monthly Cash Flow and Cash Invested for Example 12-6

MONTH	MONTHLY CASH FLOW (\$)		CASH GENERATED (\$)	
	<i>n'</i>	<i>n</i>	<i>n'</i>	<i>n</i>
June	-19,200	-19,200	-19,200	-19,200
July	-45,700	-25,200	-64,900	-44,400
Aug.	-109,700	-5,300	-154,100	-49,700
Sept.	-129,800	-500	-179,500	-50,200
Oct.	-151,900	27,100	-202,100	-23,100
Nov.	-149,200	57,500	-172,300	34,400
Dec.	-145,300	50,700	-110,900	85,100

The monthly cash flows and the cash generated from the project are calculated in the same manner and are shown in Table 12-7.

The maximum amount of cash invested occurs in October with a value of \$202,100. The cash generated by Example 12-6 is shown in Figure 12-10.

Example 12-6 could be solved using a spreadsheet by simply listing all of the houses to be started during the year in the rows and listing the month in the columns. For each of the housing starts the monthly cash flows are entered under the month in which the cash flows occur. Finally, the monthly cash flows are added up and the total cash invested for each month is calculated. This is performed for both the end of the month and just before the payment is received. The spreadsheet solution for Example 12-6 is shown in Figure 12-11.

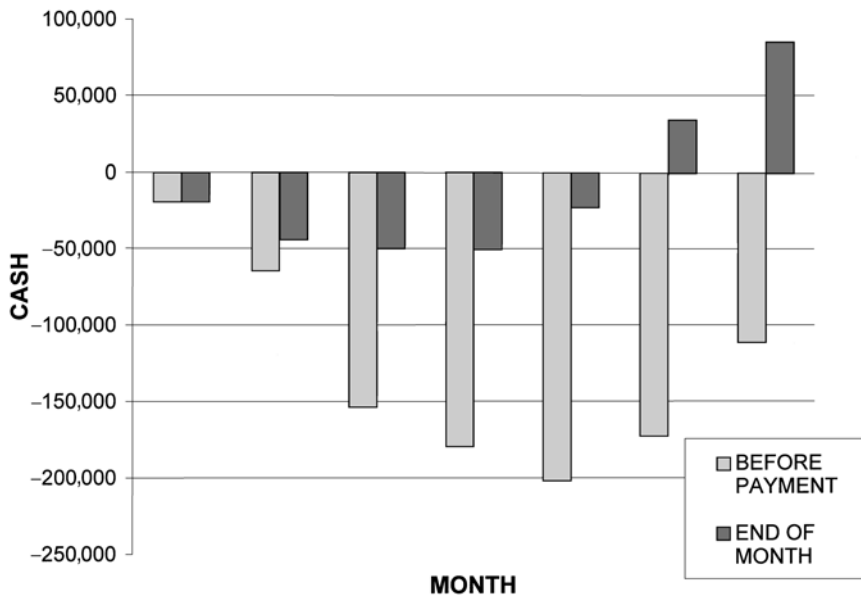


FIGURE 12-10 Cash Generated by the Project in Example 12-6

	A	B	C	D	E	F	G	H	I
1	Before Payment Is Received								
2		Starts	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3	June	Type 1	(5,800)	(8,400)	(17,100)	(4,800)	(2,100)	—	—
4		Type 2	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)	—	—
5		Type 2	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)	—	—
6	July	Type 1	—	(5,800)	(8,400)	(17,100)	(4,800)	(2,100)	—
7		Type 1	—	(5,800)	(8,400)	(17,100)	(4,800)	(2,100)	—
8		Type 2	—	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)	—
9	Aug.	Type 1	—	—	(5,800)	(8,400)	(17,100)	(4,800)	(2,100)
10		Type 2	—	—	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)
11		Type 2	—	—	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)
12	Sept.	Type 2	—	—	(6,700)	(9,500)	(20,200)	(4,800)	(1,900)
13		Type 1	—	—	—	(5,800)	(8,400)	(17,100)	(4,800)
14		Type 1	—	—	—	(5,800)	(8,400)	(17,100)	(4,800)
15	Oct.	Type 1	—	—	—	(5,800)	(8,400)	(17,100)	(4,800)
16		Type 2	—	—	—	(6,700)	(9,500)	(20,200)	(4,800)
17		Type 1	—	—	—	—	(5,800)	(8,400)	(17,100)
18	Nov.	Type 2	—	—	—	(6,700)	(9,500)	(20,200)	(20,200)
19		Type 2	—	—	—	—	(6,700)	(9,500)	(20,200)
20		Type 1	—	—	—	—	—	(5,800)	(8,400)
21	Dec.	Type 1	—	—	—	—	—	(5,800)	(8,400)
22		Type 2	—	—	—	—	—	(6,700)	(9,500)
23		Type 2	—	—	—	—	—	(6,700)	(9,500)
24	Cash Flow	Type 1	—	—	—	—	—	—	(5,800)
25		Type 1	—	—	—	—	—	—	(5,800)
26		Type 2	—	—	—	—	—	—	(6,700)
27	Type 2	—	—	—	—	—	—	—	(6,700)
28	Cash Flow		(19,200)	(45,700)	(109,700)	(129,800)	(151,900)	(149,200)	(145,300)
29	Cash		(19,200)	(64,900)	(154,100)	(179,500)	(202,100)	(172,300)	(110,900)
30									
31	End of Month								
32		Starts	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
33	June	Type 1	(5,800)	(1,900)	7,500	2,300	3,100	10,500	—
34		Type 2	(6,700)	(2,500)	9,700	3,000	3,600	12,800	—
35		Type 2	(6,700)	(2,500)	9,700	3,000	3,600	12,800	—
36	July	Type 1	—	(5,800)	(1,900)	7,500	2,300	3,100	10,500
37		Type 1	—	(5,800)	(1,900)	7,500	2,300	3,100	10,500
38		Type 2	—	(6,700)	(2,500)	9,700	3,000	3,600	12,800
39	Aug.	Type 1	—	—	(5,800)	(1,900)	7,500	2,300	3,100
40		Type 2	—	—	(6,700)	(2,500)	9,700	3,000	3,600
41		Type 2	—	—	(6,700)	(2,500)	9,700	3,000	3,600
42	Sept.	Type 2	—	—	(6,700)	(2,500)	9,700	3,000	3,600
43		Type 1	—	—	—	(5,800)	(1,900)	7,500	2,300
44		Type 1	—	—	—	(5,800)	(1,900)	7,500	2,300
45	Oct.	Type 1	—	—	—	(5,800)	(1,900)	7,500	2,300
46		Type 2	—	—	—	(6,700)	(2,500)	9,700	3,000
47		Type 1	—	—	—	—	(5,800)	(1,900)	7,500
48	Nov.	Type 2	—	—	—	—	(6,700)	(2,500)	9,700
49		Type 2	—	—	—	—	(6,700)	(2,500)	9,700
50		Type 1	—	—	—	—	—	(5,800)	(1,900)
51	Dec.	Type 1	—	—	—	—	—	(5,800)	(1,900)
52		Type 2	—	—	—	—	—	(6,700)	(2,500)
53		Type 2	—	—	—	—	—	(6,700)	(2,500)
54	Cash Flow	Type 1	—	—	—	—	—	—	(5,800)
55		Type 1	—	—	—	—	—	—	(5,800)
56		Type 2	—	—	—	—	—	—	(6,700)
57	Type 2	—	—	—	—	—	—	—	(6,700)
58	Cash Flow		(19,200)	(25,200)	(5,300)	(500)	27,100	57,500	50,700
59	Cash		(19,200)	(44,400)	(49,700)	(50,200)	(23,100)	34,400	85,100

FIGURE 12-11 Spreadsheet Solution to Example 12-6

CASH FLOW FOR PROJECTS WITH A SINGLE PAYMENT

Projects with a single payment differ in three ways from projects where the construction company receives progress payments from the project's owner. First, because there are no progress payments the peak amount of cash required is equal to the cash required at the end of the month for all but the last month when the payment is received. Second, retention is not held because there are no progress payments. Third, the construction company may also be paying some, if not all, of the soft costs. Soft costs include payments for the following: the purchase of the land; engineering and design fees; permitting and other fees charged by government entities; construction interest and loan fees; taxes and insurance; and other costs not typically included in the payments to the construction company.

Example 12-7: The construction company in Example 12-3 decides to act as the owner on the project. The construction company plans to sell the project for \$1,350,600 at the end of the seventh month. In addition to the construction costs the construction company has the following soft costs: land purchase, \$200,000; engineering and design fees, \$30,000; building permits, \$5,600; government fees, \$20,000; and other miscellaneous costs, \$15,000. The soft cost will be paid at the end of month zero. The construction company pays material suppliers in full on the last day of the month following the month the materials were supplied to the project. For example, materials supplied during the first month will be paid for at the end of the second month. The subcontractors will be paid on the same schedule as the suppliers; however, the construction company will withhold 10% retention from the subcontractors' payments, which will be paid to the subcontractors at the end of the seventh month. The construction company pays for labor weekly. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before the payment is received. What is the maximum amount of cash invested by the company during the completion of the project?

Solution: As in the other examples we begin at the beginning of the project and work our way to the end of the project, calculating the cash flow and total cash generated as we go. Because only one payment is received for the project, which occurs during the seventh month, we need to calculate only the cash flow and total cash generated at the end of the month for the first six months. For the seventh month the cash flow and total cash generated will need to be calculated at the point in time just before the project is sold and after the project is sold.

Because the first costs occur during month zero we begin by calculating the cash flow for month zero. The total cash disbursements for the soft costs are as follows:

$$\begin{aligned}\text{Cash Disbursements}_0 &= \$200,000 + \$30,000 + \$5,600 \\ &\quad + \$20,000 + \$15,000 \\ \text{Cash Disbursements}_0 &= \$270,600\end{aligned}$$

The cash flow for month zero is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_0 = \$0 - \$270,600 = -\$270,600$$

The total cash generated at the end of month zero is calculated using Eq. (12-2) as follows:

$$\text{Cash}_0 = \$0 + (-\$270,600) = -\$270,600$$

No payments to material suppliers or subcontractors will be made during the first month. During the first month the construction company will pay \$34,900 for labor. The cash flow for the first month is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_1 = \$0 - \$34,900 = -\$34,900$$

The total cash generated at the end of the first month is calculated using Eq. (12-2) as follows:

$$\text{Cash}_1 = -\$270,600 + (-\$34,900) = -\$305,500$$

At the end of the first month the construction company will need to have \$305,500 of cash invested in the project.

During the second month the construction company will pay out \$30,400 to material suppliers and \$48,900 to cover the cost of the labor. The construction company will have to pay for the first month's subcontractor costs, less the 10% retention. The monthly subcontractor payments are as follows:

$$\text{Subcontractor Payments}_2 = \$54,700(0.90) = \$49,230$$

The cash flow for the second month is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_2 = \$0 - (\$30,400 + \$48,900 + \$49,230) = -\$128,530$$

The total cash generated at the end of the second month is calculated using Eq. (12-2) as follows:

$$\text{Cash}_2 = -\$305,500 + (-\$128,530) = -\$434,030$$

The cash flow and cash generated for the third through the sixth months are calculated in a similar manner and are shown in Table 12-8.

The next point in time when we need to perform our calculation is just before the payment is received for the project. By this time the construction company has paid no additional costs; therefore, the total cash

TABLE 12-8 Monthly Cash Flow and Cash Invested for Example 12-7

MONTH	MONTHLY CASH FLOW (\$)	CASH GENERATED (\$)
0	-270,600	-270,600
1	-34,900	-305,500
2	-128,530	-434,030
3	-241,820	-675,850
4	-237,260	-913,110
5	-151,520	-1,064,630
6	-98,500	-1,163,130
7'	0	-1,163,130
7	1,243,130	80,000

generated is equal to the total cash generated at the end of the previous month, which is \$1,163,130.

The payment of \$1,350,600 for the project is received at the end of the seventh month. At the end of the seventh month the construction company will pay out \$15,400 to material suppliers and will pay the subcontractors the retention held during the first six months plus the full amount of the work performed by the subcontractors during the sixth month. The retention held during the first six months is as follows:

$$\begin{aligned} \text{Retention} &= \$0 + \$54,700(0.10) + \$123,800(0.10) \\ &\quad + \$136,400(0.10) + \$106,800(0.10) + \$66,000(0.10) \end{aligned}$$

$$\text{Retention} = \$48,770$$

The seventh month's payment to the subcontractors is as follows:

$$\text{Subcontractor Payments}_7 = \$48,770 + \$43,300 = \$92,070$$

The cash flow for the seventh month is calculated using Eq. (12-1) as follows:

$$\text{Cash Flow}_7 = \$1,350,600 - (\$15,400 + \$92,070) = \$1,243,130$$

The total cash generated at the end of the seventh month is calculated using Eq. (12-2) as follows:

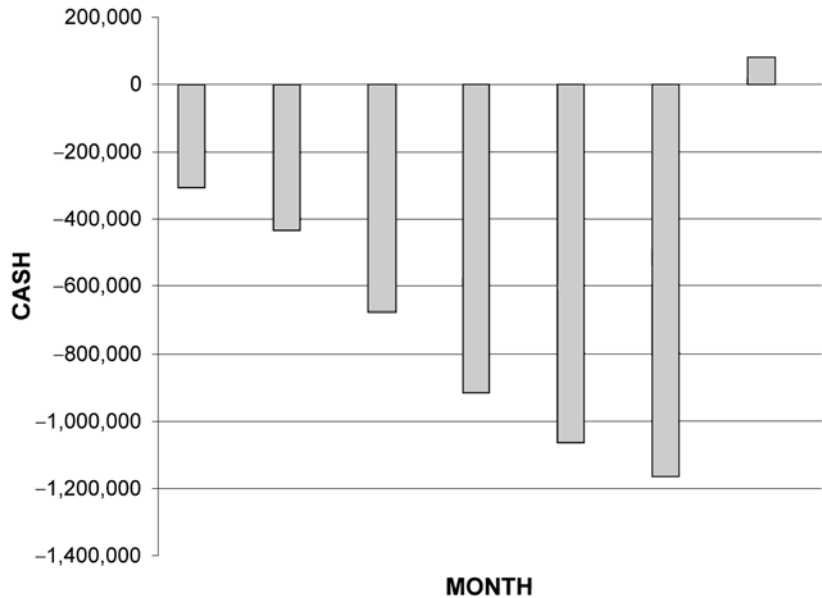
$$\text{Cash}_7 = -\$1,163,130 + \$1,243,130 = \$80,000$$

At this point the project is complete. The monthly cash flow and the cash generated at the end of each month are shown in Table 12-8.

At the completion of the project the cash generated by the project should equal the profit and overhead realized on the project, which equals the profit and overhead markup for this example. The cash generated by the project is shown in Figure 12-12.

The maximum amount of cash needed by the construction company occurs just before the payment is received. For the construction company to complete this project, it would need at least \$1,163,600 in cash.

FIGURE 12-12 Cash
Generated by the Project in
Example 12-7



From this example we see that the construction company's needs for cash continue to increase throughout the life of the project with the maximum amount of cash required occurring just before the payment for the project is received, in this case when the project is sold.

CONCLUSION

A construction company needs cash to pay bills and labor costs while it waits to receive revenue from the construction project. A lack of cash is a major source of failure for construction companies.

For construction companies that receive progress payments, the greatest need for cash on an individual project occurs each month just before payment is received from the owner. Additionally, the amount of cash tied up in the form of retention increases as the work progresses. The cash needs—excluding cash tied up in the form of retention—is greatest when the rate of progress is greatest. A construction company can reduce its cash needs by increasing its use of subcontractors, thereby using the subcontractor's cash; reducing the retention rate; increasing its profit and overhead markup on the project; or decreasing the maximum rate of progress on the project. The latter may be accomplished by leveling the work so that it occurs at a more uniform rate or by performing the work over a greater period of time. Performing the work over a greater period of time causes other problems, such as increasing overhead costs.

For the construction company that receives a single payment at the completion of the project, the maximum cash requirement occurs just before the payment is received.

PROBLEMS

1. A construction company is negotiating on a construction project with a six-month duration. On the last day of each month the construction company may bill the owner for the work completed during the month. The owner pays the monthly bills one month after they are received. The owner also holds a 5% retention. Final payment is expected one month after completion of the project and includes payment of the retention. The construction company pays material suppliers in full when it receives payment from the owner. The construction company pays subcontractors when it receives payment from the owner but withholds 5% retention from the subcontractor's payment. The construction company pays for labor weekly. The projected monthly material, labor, and subcontractor costs as well as the amount the construction company will bill the project's owner each month are shown in the following table. Determine the monthly cash flows and the total cash generated by the project at the end of each month and just before each payment is received from the project's owner. What is the maximum amount of cash invested by the company during the completion of the project?

MONTH	COSTS			BILL TO OWNER (\$)
	MATERIALS (\$)	LABOR (\$)	SUB. (\$)	
1	8,800	8,100	13,100	33,000
2	14,200	11,900	31,400	63,200
3	21,000	19,800	31,700	79,800
4	6,800	7,600	28,100	46,800
5	5,100	7,000	17,900	33,000
6	4,100	4,100	9,300	19,200
Total	60,000	58,500	131,500	275,000

2. A construction company is negotiating on a construction project with a six-month duration. On the last day of each month the construction company may bill the owner for the work completed during the month. The owner pays the monthly bills 15 days after they are received. The owner also holds a 10% retention. Final payment is expected one month after completion of the project and includes payment of the retention. The construction company pays material suppliers in full when it receives payment from the owner. The construction company pays subcontractors when it receives payment from the owner but withholds 10% from the subcontractor's payment. The construction company pays for labor weekly. The projected monthly material, labor, and subcontractor costs follow. Determine the monthly cash flows and the total cash generated by the project at the end of

each month and just before each payment is received from the project's owner. What is the maximum amount of cash invested by the company during the completion of the project?

MONTH	COSTS			BILL TO OWNER (\$)
	MATERIALS (\$)	LABOR (\$)	SUB. (\$)	
1	33,700	25,300	35,600	101,200
2	54,100	42,400	125,200	237,200
3	69,600	77,900	93,600	258,000
4	17,200	17,900	105,700	150,700
5	14,700	21,900	60,400	103,800
6	11,600	12,700	35,600	64,100
Total	200,900	198,100	456,100	915,000

3. A construction company is bidding on a contract to build homes for a developer. The project consists of two types of homes and is scheduled to begin in September. The expected monthly housing starts, the cash flow that occurs between the end of the previous month and receipt of payment from the owner, and the cash flow for the entire month are shown below. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before each payment is received from the project's owner for the remaining months in the year. What is the maximum amount of cash invested by the company during the remaining months of the year?

Monthly Starts by Type

MONTH	TYPE 1	TYPE 2
Sept.	2	4
Oct.	2	2
Nov.	3	3
Dec.	1	2

MONTH	BEFORE PAYMENT IS RECEIVED (n') (\$)		END OF MONTH (n) (\$)	
	TYPE 1	TYPE 2	TYPE 1	TYPE 2
1	-5,400	-6,500	-5,400	-6,500
2	-8,200	-8,700	-1,800	-2,400
3	-15,500	-19,800	7,300	9,300
4	-4,400	-4,400	2,200	2,800
5	-2,000	-1,700	3,000	3,400
6	0	0	9,500	11,900

4. The housing contract from Problem 3 continues on into the next year, with the last housing start occurring in April, as shown in the following table. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before each payment is received from the project's owner for the remaining months in the year. What is the maximum amount of cash invested by the company during this year?

Monthly Starts by Type

MONTH	TYPE 1	TYPE 2
Jan.	4	2
Feb.	2	2
March	3	3
April	2	1

5. The construction company in Problem 1 decides to act as the owner on the project. The construction company will be paid \$500,000 for the project at the end of the seventh month. In addition to the construction costs, the construction company has the following soft costs: land purchase, \$150,000; engineering and design fees, \$15,000; building permits, \$3,000; government fees, \$5,000; and other miscellaneous costs, \$10,000. The soft costs will be paid at the end of month zero. The construction company pays material suppliers in full on the last day of the month following the month the materials were supplied to the project. The subcontractors will be paid on the same schedule as the suppliers; however, the construction company will withhold 5% retention from the subcontractors' payments, which will be paid to the subcontractors at the end of the seventh month. The construction company pays for labor weekly. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before the payment is received. What is the maximum amount of cash invested by the company during the completion of the project?
6. The construction company in Problem 2 decides to act as the owner on the project. The construction company plans to sell the project for \$1,250,000 at the end of the seventh month. In addition to the construction costs the construction company has the following soft costs: land purchase, \$250,000; engineering and design fees, \$30,000; building permits, \$7,000; government fees, \$15,000; and other miscellaneous costs, \$10,000. The soft costs will be paid at the end of month zero. The construction company pays material suppliers in full on the fifteenth day of the month following the month the materials were supplied to the project. For example, materials supplied during the first month will be paid for on the fifteenth of the second month. The subcontractors will be paid on the same schedule as the suppliers; however, the construction company will withhold 10% retention from the subcontractors' payments, which will be paid to the subcontractors on the fifteenth day of the seventh month. The construction company pays for

labor weekly. Determine the monthly cash flows and total cash generated by the project at the end of each month and just before the payment is received. What is the maximum amount of cash invested by the company during the completion of the project?

7. Set up a spreadsheet to solve Problem 1.
8. Set up a spreadsheet to solve Problem 2.
9. Set up a spreadsheet similar to Figure 12-11 to solve Problem 3.
10. Set up a spreadsheet similar to Figure 12-11 to solve Problem 4.
11. Set up a spreadsheet to solve Problem 5.
12. Set up a spreadsheet to solve Problem 6.
13. Determine the monthly cash flows and total cash generated at the end of each month and just before the payment is received for the construction of a house with the following budget and schedule. On the last day of each month the construction company may bill the owner for the work completed during the month. The owner pays the monthly bills one month after they are received. The owner also holds a 10% retention. Final payment is expected one month after completion of the project and includes the retention. The construction company pays material suppliers in full when it receives payment from the owner. The construction company pays subcontractors when it receives payment from the owner but withholds a 10% retention from the subcontractor's payment. The construction company pays weekly for labor. Often costs will be paid throughout the month that costs are incurred. The projected monthly material, labor, subcontractor, and other costs follow. The construction company will add a 10% profit and overhead markup to these costs when billing the owner. Solve this problem using a spreadsheet.

ITEM	MAT. (\$)	LABOR (\$)	SUB. (\$)	OTHER (\$)	START	FINISH
Sanitary Sewer	0	0	1,500	0	4-Jun	4-Jun
Water Line	0	0	1,500	0	6-Jun	7-Jun
Excavation	0	0	2,500	0	8-Jun	11-Jun
Footing and Foundation	3,490	3,750	0	0	12-Jun	20-Jun
Sub-rough Plumbing	0	0	2,000	0	21-Jun	22-Jun
Slab/Floor	1,150	600	0	0	25-Jun	26-Jun
Rough Carpentry	18,560	12,340	0	0	27-Jun	31-Jul
Ext. Doors and Windows	4,800	1,000	0	0	1-Aug	3-Aug
Rough Plumbing	0	0	4,000	0	6-Aug	8-Aug
Rough HVAC	0	0	3,750	0	9-Aug	10-Aug
Rough Electrical	0	0	3,000	0	13-Aug	14-Aug
Insulation	0	0	1,650	0	17-Aug	17-Aug
Drywall	0	0	4,000	0	22-Aug	29-Aug

(continued)

ITEM	MAT. (\$)	LABOR (\$)	SUB. (\$)	OTHER (\$)	START	FINISH
Doors and Trim	6,250	1,000	0	0	30-Aug	4-Sep
Paint	0	0	2,500	0	5-Sep	12-Sep
Cabinetry	0	0	6,800	0	13-Sep	17-Sep
Overhead Door	0	0	600	0	13-Sep	13-Sep
Shower Surround	0	0	1,350	0	18-Sep	19-Sep
Hardware and Bath Access.	900	300	0	0	20-Sep	21-Sep
Ceramic Tile	0	0	2,500	0	24-Sep	27-Sep
Floor Coverings	0	0	5,000	0	28-Sep	2-Oct
Finish Plumbing	0	0	2,000	0	3-Oct	5-Oct
Finish Mechanical	0	0	1,250	0	8-Oct	8-Oct
Finish Electrical	0	0	3,000	0	9-Oct	10-Oct
Appliances	2,300	200	0	0	11-Oct	11-Oct
Blinds	1,000	0	0	0	12-Oct	12-Oct
Roofing	0	0	2,070	0	17-Aug	21-Aug
Masonry	0	0	2,650	0	22-Aug	28-Aug
Siding	0	0	3,870	0	29-Aug	4-Sep
Rain Gutters	0	0	500	0	5-Sep	5-Sep
Site Concrete	1,365	1,220	0	0	6-Sep	12-Sep
Fencing	0	0	4,500	0	13-Sep	19-Sep
Landscaping	0	0	5,000	0	20-Sep	26-Sep
Supervision	0	2,000	0	0	1-Jun	18-Oct
Temporary Utilities	0	0	0	2,100	1-Jun	18-Oct
Trash Disposal	0	0	0	1,500	1-Jun	18-Oct
Building Permit	0	0	0	1,000	1-Jun	1-Jun
Clean Up	0	750	0	0	17-Oct	18-Oct
Total	39,815	23,160	67,490	4,600		