

Provisions for Sanitation Facilities

at Construction Sites

(Adjusted to reflect 22 work days/month)

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Executive Summary

1. Data collected at area construction sites show that contractors provide a minimum number of sanitation facilities necessary to meet basic needs. Because of the physical dispersion of workers and equipment, contractors can achieve net savings in costs by providing additional sanitation facilities in convenient locations.
2. Direct cost savings can be measured using four different methods:
 - a. Break-even time savings,
 - b. Break-even distance savings,
 - c. Net cost savings,
 - d. Savings as a percentage of costs.
3. Benefits provided by each additional facility generally decrease as the number of facilities on the work site increases. A break-even point can be determined beyond which additional facilities fail to provide sufficient benefits to justify their cost. Contractors tend to operate considerably below the break-even point. Obstacles on work sites and access for service should also be considered when determining the costs and benefits from additional units.
4. Facilities that are incorrectly placed on the work site will result in less than optimal benefits. Sanitation facilities are like all the other necessary work site equipment in that they must be made as available as possible. Each group of 7 or more workers should generally have a facility within 100 feet of the group's central location.
5. An experiment on improving accessibility of facilities was conducted in which three work sites were given one free facility each. Average time savings required each day to pay the cost of the facility for the three work sites was 23.33 seconds for each worker using the facility. The average net cost savings provided by just the one facility was **\$13.86** per day. The average savings, as a percentage of costs the contractors would have received had they invested in the facility, was **623%**.
6. Average direct benefits at the four types of construction sites studied are **\$14.24** per day in net cost savings (**587%** of the cost of the facility).
7. Indirect benefits also provided by additional facilities were:
 - a. Savings in workers' break-time,
 - b. Cleaner and more sanitary work environments,
 - c. Greater comfort for workers on the job,
 - d. Cleaner facilities because of less use per unit.
8. Each of the work sites studied could benefit from additional facilities. This improvement can be accomplished by adding facilities until each group of 7 or more workers has a closely placed unit.

Introduction

Many construction companies provide their workers with the minimum number of portable sanitation facilities required to meet basic needs without considering the benefits these facilities provide. Basic needs can be met by providing one unit for every fifteen workers on a work site. The purpose in setting a maximum capacity figure of fifteen workers per unit is to prevent deterioration of chemicals used in the units. This criterion for supplying sanitation facilities on work sites will not necessarily provide workers with close and easily available facilities that save valuable work time. It is in the contractor's best interests to see that workers on their sites are supplied with all the necessary equipment to work in a productive manner. Contractors may be foregoing worker productivity and satisfaction by not supplying job sites with enough sanitation facilities. These contractors may not be aware of the benefits provided by well-placed sanitation facilities. Accordingly, a study was conducted to identify the types of benefits contractors can expect from improving availability of sanitation facilities at their work sites. This report contains the results of the study.

The purpose of this study is to examine the present arrangement of facilities on work sites, determine and measure the benefits provided both by present and additional facilities and develop a method of placing facilities on a work site to provide optimal accessibility and benefits.

Data Collection

Data was collected through observations of work site activities and interviews with workers and supervisors. One home construction, one highway construction, one utility work site and two high rise construction sites were selected to represent the St. Louis, Missouri area work sites in this study. Data collected covered labor and equipment, layouts of the work sites, usage and placement of facilities and opinions of workers and supervisors on the benefits provided by sanitation facilities. Each of the four types of work sites is discussed in turn.

Home Construction Site

Most labor and equipment at the home construction site was provided by subcontractors. During the course of the study the number of subcontract workers at the site varied between twelve and twenty. In addition, there were two or three pieces of subcontracted equipment with operators. Subcontract labor cost was \$25 to \$30 per hour. Subcontract equipment cost was \$65 to \$125 per hour including the operator. Five to seven company employees also worked at the site. Company employees are paid \$15 per hour. The cost to the company including fringe benefits and taxes is about \$20 per hour. Two of the company employees were supervisors which cost the company about \$25 per hour.

The home construction site consisted of condominium buildings. Two buildings were under construction at the beginning of the study. Three more buildings were started during the study. There were five main areas of activity throughout the subdivision. Three activity areas were condominium buildings. The fourth area was the supervisor's trailer which was also where one of the new buildings was started. The fifth area was where fields were being graded for streets

and future buildings. The workers at this home construction site were the second most widely dispersed group of workers out of the five work sites. Although the workers worked closely together in the buildings, the buildings had some distance between them. Improving accessibility by adding facilities is relatively easy on sites with widely dispersed workers.

The site had two sanitation facilities at the start of the study. Each of the two buildings under construction had one facility placed in front. A third unit was placed next to a newly started building as part of an experiment to measure benefits. The field and supervisor's trailer did not have a closely placed unit. Near the end of the study one of the units was moved next to the trailer. The unit placed in front of the building near completion received light use since there were only five subcontract workers at the building. The other units received twice as much use.

The main benefits provided by sanitation facilities from the supervisor's viewpoint was keeping the work environment cleaner and saving the time of the more expensive subcontractors. The supervisor's main concern was keeping the work environment clean, especially in the later stages of construction. He felt that the company's image of building quality homes is important. Many individuals outside the company such as subcontractors and customers see the homes as they are being built.

From the worker's viewpoint, the main benefit provided by a close facility was in not having to walk long distances or to make unsanitary arrangements in or around the houses under construction. These workers seemed interested in time savings, clean work environments and privacy.

Utility Work Site

The utility work site consisted of a mobile crew of four workers and one supervisor. Average wages for the workers were \$11.50 per hour; cost to the company with taxes and fringe benefits was about \$15 per hour. The supervisor and one of the workers cost the company \$20 per hour each. Two pieces of equipment were assigned to this crew when they were observed. The number and type of equipment assigned to a crew depends on the needs of the job they are doing. Equipment costs vary from \$30 to \$40 per hour.

The main activity of the work crew was installing sections of gas lines off a main gas line in an industrial park and then in a subdivision. The section of line installed at the industrial park was about 800 feet long. These two sites were the third most widely dispersed of the different types of sites. Dispersion of activity at utility job sites depends on the particular job.

Each crew is assigned one facility which is moved from job to job with the rest of the equipment. The unit is usually placed by the trailers used to move the equipment. The job supervisor felt that the main reason in having a sanitation facility was to satisfy an OSHA regulation but did admit that the presence of the facility saved time and prevented workers from making unsanitary arrangements. One of the district supervisors was unaware of any OSHA regulation and said that the main reason for providing a facility was to save time. Both of these supervisors estimated the time savings provided by the facility to be fifteen minutes for each worker per work day.

High Rise Construction Site

Two high rise construction sites were considered for the study, but only one was used because of similarities between the two. Employees cost the company from \$22 to \$25 per hour based on wages of \$15.50 to \$17.00 per hour. There were 250 to 300 employees working two 8 hour shifts per day. Equipment costs were stated as a total for the project, making a direct economic measure difficult. However, much of the equipment, such as the crane and service elevator, is vital to productive work.

The construction site consisted of an eight-story hotel and a parking lot. Each shift has from 125 to 150 workers, making these workers the least dispersed of the four types of sites. Eight sanitation facilities had been provided at the start of the structures. Seven of these units were special "Low Boy" units designed for use in high rise structures. The eighth unit was located by the supervisor's trailer. These facilities received service more than once a week. Toward the end of the construction project, much of the activity was on the grounds surrounding the structure. There, the experimental facility was added to provide easier access for these workers.

The supervisor felt that the benefits he considered most important were saving the worker's time and providing workers with comfortable facilities. Out of all the supervisors from the various sites, the supervisor of the high rise construction site seemed the most concerned with making the facilities as available as possible. The supervisor said that even when facilities are made very accessible, there will still be a few individuals who will not use them for one reason or another, but the level of use depends on how accessible the units are.

Highway Construction Site

Several adjacent work sites from three different companies were all located within the same area. One company's site was selected for investigation and used in an experiment to determine benefits provided by an additional facility. The costs for labor and equipment fluctuated from day to day depending on the number and type of workers and equipment on the site each day. Most of the workers on the site were equipment operators that cost the company from \$25 to \$30 per hour. The estimated cost for equipment was \$60 to \$100 per hour. The total cost of equipment and operators is, therefore, between \$85 and \$130 per hour.

The work site consisted of grading and earth moving in several fields. During the study, the site was dormant on several days due to weather conditions. There were 30 to 40 workers on active days grading the various fields. This site was the most widely dispersed of the four types of sites in the study. Three facilities were provided for the workers.

The site supervisor felt that the most important benefit provided by accessible sanitation facilities was time savings. Because of weather conditions, as much work as possible must be completed on the few days they are able to work. There must be some facilities close to the men so that they can make the most of project days.

Benefits from Improving Accessibility to Sanitation Facilities

We now consider the direct and indirect benefits that occur from increasing access to sanitation facilities. Direct benefits are the easily measured cost savings from decreasing worker's down time as they travel to and from facilities. Indirect benefits come from improving the work environment.

Direct Benefits

Direct benefits are the essential basis for justifying contractor's expenditures on facilities. Most contractors require direct economic justification for spending more on facilities. Break-even time and distance savings can be calculated to determine the minimum direct economic benefits required to justify the cost of an additional unit. Net cost savings and savings as a percentage of costs can be used to measure the improvement made possible by renting a facility.

A relationship exists between time and cost. Cost savings are incurred in direct proportion to time savings. The time savings from improving worker's accessibility to facilities may occur in two ways: (1) Reducing the distance workers must travel to use a sanitation facility; and (2) Reducing the time workers spend searching for a place to make unsanitary alternatives because no close facility has been provided.

Break-Even Time Savings

Placing sanitation facilities closer to the workers requires adding facilities on many work sites because of the wide dispersion of the workers. Adding a facility will shorten the distance workers must travel or prevent workers from having to use unsanitary alternatives, thereby producing time savings. The time savings necessary to justify adding a facility is easily calculated by using the cost for the facility and the costs for the group of workers that will use the facility. The time savings that, when multiplied by the workers cost, will equal the cost of the facility is called the break-even time savings since the renter of the facility is just breaking even on his investment. The usefulness of the break-even calculation is in providing a figure for the minimum benefits necessary to warrant making the investment.

For example, suppose a new block of condominiums is being constructed by twelve subcontract workers at a home construction site. The twelve workers must now travel to a facility placed in front of another block of condominiums or make other arrangements. The supervisor would like to place another unit in front of the building but he is not sure the time savings will pay for the facility. Break-even time savings can be computed to help him decide.

The twelve workers consist of nine subcontractor workers at a cost of \$25 per hour each and three subcontract workers at \$30 per hour or \$315 per total hour. Each different labor cost to the company is multiplied by the number of workers at that cost. These totals are then added to get the total for the group of workers. Estimating the total costs of a group of workers is outlined in detail in Appendix A.

If one hour of time could be saved for this group of workers each day, the company would save \$315 each day on the cost of completing the project. Since the daily **working** cost of the facility for this work site is only **\$2.84** (\$62.50 per month/per unit divided by **22** working days per month), much less than one hour of time savings per day is needed to pay for the facility. To calculate the minimum time savings needed, first convert the \$315 per hour to minutes by dividing by 60 so that the time savings will be expressed in minutes. The total cost per minute for workers is \$5.25 which is still more than the cost of the facility. If **.541** of one minute could be saved, the company will save **\$2.84** which equals the cost of the facility (**.541 x 5.25 = \$2.84**). The simple formula used to find the break-even time savings is:

$$\frac{\text{Cost of one facility per working day}}{\text{Total cost of workers per minute}} = \text{Average labor time savings in minutes per worker per day (or work shift) needed to justify adding one unit.}$$

The formula expresses the time savings that each worker using the facility must save each work day to pay the daily cost of the facility. In this case, each of the twelve workers on average must save **.541** minutes or **32.5** seconds (.541 min. x 60 sec.) to pay to cost of the facility which would be placed in front of the building they are constructing.

Break-Even Distance Savings

The minimum benefits necessary to pay the cost of a facility can be measured in distance savings. The minimum distance savings needed to pay for the facility is directly related to the minimum time savings since it takes workers a certain time to cover a certain distance. Distance savings assumes that workers are traveling to a specific location before a facility is added. This location must be known to measure distance.

Break-even distance savings can be calculated with facility and work group costs, approximate number of trips made to the facility per day and the approximate time needed to make a trip. Only trips made directly to and from the facility during working hours should be counted because these trips represent the loss of productive work time due to the location of the facility. Shortening the distance traveled will benefit the company directly in cost savings on some of the trips made each day. The rest of the trips benefit the workers by allowing them to make the most of their break time. Out of two to four trips per day, usually two and at most three trips per day, should be used. The travel rate will vary depending on work site conditions, such as obstacles. An average rate of about 2.5 miles per hour or 220 feet per minute is used in the formula.

Using the high-rise construction site as an example, if there are ten workers at a cost of \$25 each, the total cost for the group is \$250 per hour. The facility cost per work shift for this site was **\$2.33** because the units received special service and there were two 8 hour work shifts per day. If the workers make an average of two trips per work shift, the distance savings necessary to pay the cost of the facility is 45 feet using the following formula:

$$\frac{\text{Facility cost per day x 220 fpm}}{\text{Total costs per minute x trips per day}} = \text{Distance savings in feet}$$

Instead of using per day figures, in this example per work shift figures are used. Distance savings were calculated by multiplying facility cost per shift by 220 fpm, then dividing by total costs per minute multiplied by trips per work shift [(\$2.33 x 220 fpm) ÷ (\$4.17 x 2 trips)] giving **61.5** feet. These calculations are covered in table form in Section Two of Appendix A.

If a new facility is to be added it must be at least 61.5 feet closer to the group of workers than their present facility. Any distance savings beyond 61.5 feet will be net cost savings for the company.

Net Cost Savings

Break-even time savings of **32.5** seconds per worker each day indicate the minimum amount of time that must be saved to recover costs of an additional sanitation unit. The break-even distance savings of **61.5** feet indicate the minimum reduction in average distance traveled to a sanitation unit required to justify costs of an additional unit. Net cost savings indicate the direct financial benefit from provision of an additional sanitation unit.

Using the home construction example, if the new facility is added and placed within 50 feet of the center of activity for the group of workers and the old facility is approximately 400 feet from the center of activity, the distance savings would be (400 - 50) = 350 feet. Dividing by the travel rate of 220 feet per minute gives time savings of (350 ÷ 220 fpm) = 1.59 minutes per trip. Multiplying the time savings by the number of trips per day (1.59 min. x 2) gives time savings per work day of 3.18 minutes. Daily time savings is then multiplied by the total cost per minute of the work group (3.18 min. x 5.25) giving daily cost savings of \$16.70. To get the net cost savings, the daily cost of the facility is subtracted from the daily cost savings (\$16.70 - \$2.84/working day) which is **\$13.86**. This process of estimating net cost savings per day can be summarized in a formula:

$$\frac{\text{Old distance in feet} - \text{New distance in feet}}{220 \text{ fpm}} \times \text{Trips per day} \times \text{Total cost per minute} - \text{Facility cost/working day} = \text{Net cost savings per day}$$

The construction company can thus save **\$13.86** per work day (after rental costs) by renting another sanitation facility to be placed by the twelve workers. The workers will also benefit by saving valuable break time. Net cost savings calculations are detailed in Section Three of Appendix A.

Savings as a Percentage of Costs

A percentage savings over costs can be used to express the return as a proportion of the investment in the facility. Instead of subtracting the facility cost from the cost savings as was done for estimating net cost savings, the cost savings is divided by the facility cost/work day (\$16.70 ÷ \$2.84) giving **\$5.88** which is then multiplied by 100 (5.88 x 100 = 588%) to express the return as a percent. The process for calculating savings as a percentage of costs can be found in the last section of Appendix A. The investment in the additional facility will return about **588%** of the cost of the facility in direct cost savings.

Direct Benefits for Utility Work Sites

Utility work sites were much smaller than the other types of sites covered in the study. The work crew that was observed only had five individuals. These small utility work sites only need one well-placed facility. Instead of measuring the benefits provided by an additional facility, the benefits provided by having a facility will be appropriate for small utility work sites. The same methods for accessing additional facilities can be used to access the benefits provided by a work crew's facility.

The observed work crew had three workers at \$15 per hour each and one worker and a supervisor at \$20 per hour each. Total company cost for this work crew is \$85 per hour. There are two types of costs for the facility. One is a monthly rental cost of \$62.50. The other is the \$18 cost to move the unit from one location to another. The observed work crew made two moves in a one month period during the study. Facility cost for that month was \$98.50. The daily break-even time savings necessary to pay for the facility during that month was about **3 minutes 9 seconds** for each of the five men. This time is much higher than the other sites because of the high facility cost and the low work crew cost.

The field and district supervisors said that each worker would waste about fifteen minutes per day searching for facilities or making alternative arrangements before a facility was provided for the crew. Using a time savings of fifteen minutes, the net cost savings provided by the facility is **\$16.80** per day. The savings as a percentage of costs is **475%**.

Effects from Improving Accessibility of Facilities at Work Sites

The four examples of identifying benefits dealt with only one group of workers. The actual sites the examples were modeled after are much larger as are many sites for home, high-rise and highway construction. Facility improvements on sites with forty or fifty workers yield significant benefits. Placing the facilities properly is necessary for maximizing the benefits derived from them. Facility placement is discussed in the next section. However, at this point, it is important to recognize that the objective of maximizing benefits comes from improving the workers accessibility to facilities, not from adding additional facilities. Because of the dispersion of workers at many work sites and the low cost of sanitation facilities, increasing accessibility may require adding facilities.

The home construction site used throughout the study had five main work centers. Three of the work centers were condominium buildings in various stages of construction. The other two were the supervisor's trailer and field grading equipment. The work site had two sanitation facilities at the start of the study and a third unit was added as part of an experiment to assess benefits. A fourth and then fifth unit was simulated on the work site. The physical presence of facilities is not necessary for measuring costs as long as workers use the closest facility, which means that a closer unit can be simulated and then assessed as though it was being used by workers.

(5)

(1) No. of Facilities	(2) Daily Cost of Facilities	(3) Total Distance Traveled	(4) Daily Cost of Lost Time	(2)+(4) Total Daily Costs	(6) Net Cost Savings	(7) Savings at a % of Costs
2	\$5.68	18,350 ft.	\$53.00	\$58.68		
3	\$8.52	10,400 ft.	\$24.00	\$32.52	\$9.12	418%
4	\$11.36	4,700 ft.	\$16.00	\$27.36	\$5.16	282%
5	\$14.20	3,900 ft.	\$8.25	\$22.45	\$4.91	273%
					\$19.19	325%

For each work center:

Total distance traveled = (Old distance in feet - New distance in feet) x Number of trips per day x Number of workers

Daily cost of lost time = $\frac{\text{Total distance traveled}}{220 \text{ fpm}}$ x Worker costs per min.

Net cost savings = Daily cost of lost time - Daily cost of facilities

Savings as a percentage cost = $\frac{\text{Cost of Savings}}{\text{Daily cost of facilities}}$

Total net cost savings of **\$19.19** and total percentage return of **325%** are the result of having five facilities as opposed to two. They measure the total improvement possible for this work site by adding three facilities. Another facility placed by the field graders probably could have been justified because of the high costs of the equipment. However, servicing the sixth unit would have been difficult because it would have to be placed at the back of the field. Adding facilities will no longer be cost justified at a certain point. This point is when the cost of the additional unit just equals the cost savings realized by the additional unit.

In work sites with high costs and widely dispersed workers, reaching the point of no further improvements may mean having facilities placed closely together with each unit serving only a few workers. Placing this many units may not be possible because of constraints on servicing the units and on having indirect benefits associated with making facilities more accessible at work sites are not as easily measured as direct benefits but are just as important. These indirect benefits were measured by interviewing workers and supervisors. Cost justifying facilities is probably most important to the contractor. Contractors should also be concerned with improving work site conditions. The indirect benefits provided by accessible facilities will help improve work site conditions.

Providing an adequate number of properly placed facilities will save workers valuable break time. The number of facilities used per day by workers is usually divided into uses on company time and uses on the worker's time. Time savings from uses on company time benefit the company directly and time savings from uses on the worker's break time benefit the worker. Workers should not have to spend part of their break searching for facilities.

An adequate number of properly placed facilities will help prevent workers from being forced to make unsanitary arrangements. Facilities that are close to the workers will provide privacy and keep the work environment cleaner. These benefits are especially important because work sites are usually seen by company officials, inspectors, customers and many other outsiders.

Providing easily accessible facilities will raise the workers' level of comfort on the job. Workers who wait until they are in a truly uncomfortable state because of lack of a close facility probably will not put out as much work per unit of time as workers who are able to make use of a close facility and avoid this uncomfortable state.

Finally, increasing the number of facilities on the work site will ease maintenance needs on all the work site units. Less need for maintenance helps ensure a high level of cleanliness. Given a certain level of service for a facility, the facility will be cleaner between servicing time if there are less workers using the facility.

Placing Facilities in the "Right" Spot

Benefits from additional facilities will not be realized if the facilities are not placed on the right spots. Benefits come from improving workers' accessibility to the facilities on the work site. Facilities should be placed in locations that are convenient and close to the workers.

Some guidelines to consider for placing facilities on work sites are:

- 1) Maximum capacity for fifteen workers per unit on regular service,
- 2) Facilities must be placed within reach of a service truck,
- 3) Facilities must not be an obstacle for equipment or workers.

In addition, our work shows that each group of 7 or more workers should have a facility placed within 100 feet of the center of its location.

This fourth requirement is necessary if the contractor is to realize the direct and indirect benefits from well-planned sanitation facility service. Using 100 feet from a center as a general guideline will ensure benefits while allowing flexibility in choosing places for facilities. Lost time costs are minimized as facilities are moved closer. Work groups that are 300 feet from a facility will lose three times more in lost time costs as a work group that is 100 feet from a facility and six times more than a work group that is 50 feet from a facility. Close facilities are very important. The following section discusses an experiment on improving accessibility which outlines direct and indirect benefits obtained by closer facilities on three different work sites.

The objective is to provide facilities so that on average each worker is within 100 feet of a unit. The workers should be separated into groups that will each receive a unit. The unit should be placed as close as possible to the center of the work group's location. The center of location for stationary groups should be easy to find. For groups that move around (e.g., field graders) the center should be where workers tend to congregate. This location may be where workers travel to for a water cooler or for tools or equipment, to take breaks, etc. and should have all the equipment, including a sanitation facility, necessary to meet the workers' needs during the work day.

On highway construction sites, consider placing facilities in the vicinity of supervisory trailers, structures under construction, heavy equipment (to avoid down time) and stationary objects (e.g., water coolers) around which workers congregate.

Larger utility work sites will be similar to highway construction sites in considerations for placing facilities. Smaller, one-crew utility work sites have a facility either in the center of the work site or by the trailers used to move equipment.

On home construction sites, consider placing facilities by supervisory trailers, each home or condominium building under construction and the central location for heavy equipment operators.

High-rise construction sites should have at least one facility on each floor with workers. Supervisory trailers, cranes, service elevators and supply inventories should also have a closely placed facility.

Keeping Facilities in the "Right" Spot

The location of activities changes over the course of the project. This is especially true on home and highway construction sites. The completion of homes or condo units and the start of new units will mean a movement of activity as well as the completion of grading a field, paving a lane, etc. Work site facilities are like any other essential equipment in that they must be employed where they will do the most good. Facilities will have to be moved to the new areas of activities if a high level of accessibility is to be maintained.

It would be in the contractors best interests to see that work site facilities are moved as necessary and they should be made aware of the importance of keeping facilities in the right place. Once it is determined that facilities should be moved, the same process can be used. Locate the new work group and its center. Then place the facility as close as possible to the center. All work groups should have a facility within 100 feet of the center of its location.

Experiment on Improving Accessibility of Facilities

The home, high-rise and highway construction sites used in the study were each given one free sanitation facility as part of an experiment to measure the benefits of improving accessibility of facilities. There were three main objectives in conducting the experiment.

1. Determining the logical problems of adding facilities to work sites. The main logistical problem is placing facilities for maximum benefits without placing it out of reach of a service truck or in the way of any work site activities.
2. Measuring the cost savings of a facility actually placed on a work site.
3. Gathering data from workers and supervisors on what they felt were the important indirect benefits provided by the additional facility.

Most of the experiment was conducted over a one week period for each site and consisted of six main steps:

1. Three customers were asked to participate in the experiment.
2. A work site from each company was selected to receive a free unit during the course of the experiment.
3. A particular location on each site estimated as needing the most improvement was selected for placement of the unit.
4. The unit was placed on the work site and the process of finding the location and placing the unit was evaluated for logistical problems.
5. Direct benefits were measured based on the actual location of the units and the number and cost of workers and their equipment that would use the unit.
6. Workers and supervisors were asked what they perceived to be the most important benefits provided by the additional unit. Then they were asked to elaborate on their response. For example, if a supervisor's response was "time savings" he was asked for an estimate, or if the response was "cleaner work environment" he was asked for reasons why a cleaner work environment was important.

The following pages contain discussions on layouts of the three sites, cost data for workers and equipment and estimated direct benefits provided by the additional unit. The direct benefits were measured as if the companies had paid for the units. Since the units were free, the direct benefits were actually higher.

Home Construction Site

Locating the facility close to the buildings, yet within range of a service truck, was not difficult since vehicles could move about easily on this home construction site. However, locating the facility so as not to be in the way of supplies used to construct the buildings and the trucks that deliver them was more of a problem. The selected place was in the way of work site activity so the workers had to move the unit over slightly.

The supervisor felt that the additional facility saved the equipment operator's time significantly. The costs for the subcontracted equipment and operators grading the field were the highest on the job since at about \$60 to \$125 per hour. The field grading was a critical activity since it must precede construction work and because of the large amount of down time due to weather conditions. The supervisor also felt that the new building next to the additional facility would stay cleaner because the twelve subcontractors would be more willing to use a facility located next to the building than a facility about 250 feet away. Cleaner buildings are especially important in the later stages of construction.

Some of the workers felt that the additional facilities would provide convenience. They said that they would avoid using facilities that are only 200 feet to 300 feet away, especially on particularly busy days. They will make other arrangements if possible or travel the distance and either situation will involve an unnecessary loss of time.

Highway Construction Site

The highway construction site selected for the experiment was only one of several work sites run by three different companies where a highway was being built for the State of Illinois. The high level of dispersment of the workers and equipment plus the large amount of time they spent in motion made finding the proper location for the additional unit somewhat difficult. The facilities location approach from the preceding section of this report was used to find the optimal location. A work group without a close facility was identified, then the center location for the group was identified. The facility was located in the middle of the center next to the workers' water cooler. This location was within reach of a service truck and out of the way of work site activities.

Before the facility was added, the workers had to either travel a quarter mile north or south to reach a presently placed facility or make other arrangements. It is not likely for workers to travel a distance of a quarter mile to use a facility. The time savings for this group of workers came from eliminating the need to find a close place to use rather than from any distance savings. Over present facilities, three minutes of time savings per worker per day was used to calculate the direct benefits. This was a minimum time savings figure estimated by a supervisor.

The supervisors felt that close facilities are necessary for productive work. Something must be provided that the workers can use without spending a lot of time. Because of bad weather conditions, the amount of time that workers have to spend on the project must be utilized to the fullest extent possible. Some of the workers felt that they should not have to make arrangements because of lack of close facilities. Convenience was important to these workers.

High-Rise Construction Site

An additional sanitation facility was added to the high rise construction site during the later stages of the construction project. Much of the activity during the later stage was outside the structure which was where an additional facility would do the most good.

The group's work center was at the base of the service drive, but because of trucks and other

equipment moving in and out of the area, the facility had to be located about 75 feet from the work center.

The supervisor felt that providing a facility close enough so that the workers will use it is very important for keeping the work environment clean and saving the workers' time. The supervisors did not want workers both inside or outside the building making unsanitary arrangements because of the many people who view the work site. These people come from the customer's company and the construction company or they may be inspectors, officials, even the general public. The work site image was important to these supervisors. They considered time savings to be of a secondary importance. Some of the workers indicated that convenience was important. They did not like traveling to different floors or remote parts of the crowded work site in search of a place to use a facility.

The results of the experiment were close to the expected results. Small differences between the expected direct benefits and those estimated after the units were added to the sites were due to limitations on possible locations. Opinions expressed by workers and supervisors indicated interest in having accessible sanitation facilities on work sites.

Summary of Results

These results are intended to cover the average direct and indirect benefits obtainable both by adding one well-placed facility at a home, high-rise and highway construction site and by having one well-placed facility at a utility work site.

Direct Benefits

Site	Time Savings per worker required each day to pay for one facility	Net Cost Savings per day provided by one facility	Savings as a % of costs
Home	22 seconds	\$13.00	550%
High-Rise	24 seconds	\$15.00	740%
Highway	24 seconds	\$14.00	590%
Utility	2 minutes 20 seconds	\$18.00	480%

The direct cost savings per day can also be used as an approximate value of a facility on a work site. For example, a high-rise construction site with eight facilities is getting approximately eight times \$15.30 or \$122.40 in cost savings per work shift. This type of approximation is only applicable within a range because the per unit benefits decrease as the number of units on the work site increase. The average net cost savings for all four sites is \$15 per day and the average savings as a percentage of costs is 600%.

Indirect Benefits

Four major indirect benefits can be realized by providing close and easily accessible sanitation facilities on work sites.

1. Saving workers valuable break time by eliminating wasted time either traveling to distant facilities or making other arrangements.
2. Cleaner work environments by workers using an easily accessible facility instead of making unsanitary arrangements.
3. Preventing workers from having to work in an uncomfortable state because an easily accessible facility has not been provided.
4. Cleaner facilities on work site. Adding facilities means less use per unit and given a certain service level per unit, all of the facilities on the work site will be cleaner.

Actually realizing these direct and indirect benefits requires correct placement of facilities for ease of access by all workers. Each group of 7 or more workers on the site should have at least one facility placed within 100 feet of its central location.

Conclusion

The construction companies in the study could realize substantial economic benefits from adding more well-placed sanitation facilities at their work sites. The home construction site could have used as many as three more units. The highway and high-rise construction sites could have used even more than three additional units. The highway construction site needed the most improvement of the three sites and was also the hardest to place facilities on because most of the workers were equipment operators who were mobile most of the day. Investigation at the utility work site used in the study indicated that the utility work crews, regardless of their small size, should have a facility.

Convincing construction companies to spend more money on sanitation facilities in order to obtain benefits may not be easy. One possible approach would be to emphasize the requirements and merits of well-planned sanitation facilities service. Based upon current costs of labor, equipment, etc., a sanitation facility should be placed within 100 feet of each group of 7 or more workers at the various types of construction sites studied.

Clearly, more units are needed than construction companies now have on their work sites. These facilities easily pay for themselves and return net cost savings because the cost of workers and their equipment is much higher than the cost of the units. Break-even time savings can be easily calculated for any work site to be used as proof of the low relative cost of facilities.

Net cost savings per day and savings as a percentage of costs can either be cited from this report as approximations or estimated with the use of the tables in Appendix A. Complete service will also ensure that workers have ease of access to a facility thus providing indirect benefits such as increased break-time, cleaner work environment, more comfort on the job and cleaner facilities.

Appendix A

Estimating Benefits Provided by Sanitation Facilities at Work Sites

Four tools can be used to measure benefits:

1. Break-even time savings.
2. Break-even distance savings.
3. Net cost savings.
4. Percentage returns.

All four use total costs per hour for the work group using the facility and the daily cost of renting the facility. Computing these two figures will be outlined first, then use of the four tools will be explained.

1. Estimate the total costs per hour for the group of workers that will be using the facility. Workers within the group may have different costs to the company. Each different cost must be multiplied by the number of workers at that cost. Estimate costs as follows:

- Costs for company employees should include wages, taxes, fringe benefits and insurance. If only wages are known, multiply the wage rate by 1.3.
- Company owned equipment costs should include both operating costs of the equipment and the cost for the operator.
- Subcontract labor and equipment costs should be stated as the per hour cost to the company.

Multiply each different estimated cost per hour in column 1 by the number of workers at that cost in column 2. Total the results in column 3 to obtain total costs per hour.

(1) Costs per hour	x	(2) Number of Workers	=	(3) Total
_____	x	_____	=	_____
_____	x	_____	=	_____
_____	x	_____	=	_____
_____	x	_____	=	_____
		Total costs per hour		_____

2. Convert total costs per hour into total costs per minute by dividing the results from Step 1 by 60.

Total cost per minute: _____

3. Calculate the daily working days cost of a facility for the work site by dividing the monthly cost by 22.

Facility cost per day: _____

Section 1: Break-Even Time Savings

4. Divide the facility cost per day by total costs per minute giving the average time savings in minutes each worker in the group must save each work day to pay the cost of one facility.

(Step 3 ÷ Step 2) = _____

Section 2: Break-Even Distance Savings

5. Multiply the total costs per minute by the estimated number of trips workers will make to the facility each day. Count only trips made during working hours going directly to and from the facility.

(Step 2 x Trips per day) = _____

6. Multiply facility cost per day by 220 feet per minute.

(Step 3 x 220) = _____

7. Divide the result from Step 6 by the result from Step 5, giving the distance in feet the work group must save to pay the cost of the facility.

Step 6 ÷ Step 5 = _____

Section 3: Net Cost Savings

8. Subtract the new distance with the additional facility from the old facility giving distance savings for the work group.

(Old distance - New distance) = _____

Or, estimate the total time savings per worker per day.

(Total time savings) = _____

9. Divide the distance savings computed in Step 8 by 220 giving the time savings in minutes per work day.

(Step 8 ÷ 220) = _____

10. Multiply total costs per minute by the estimated number of trips workers will make to the facility each day. Count only trips made during working hours going directly to and from the facility.

(Step 2 x Trips/day) = _____

11. Multiply the time savings computer in Step 9, or the total time savings from Step 8, by the result from Step 10, giving cost savings.

(Step 9 x Step 10) = _____

12. Subtract the facility cost per work day from the cost savings computed in Step 11 giving net cost savings.

(Step 11 - Step 2) = _____

Section 4: Savings as a Percentage of Costs

13. Divide the cost savings computed in Step 11 by the facility cost per work day.

(Step 11 ÷ Step 3) = _____

14. Multiply the result in Step 13 by 100 giving the daily percentage return on the cost of the facility.

(Step 13 x 100) = _____