Schedule Acceleration Analysis

Executive Summary

The existing design schedule for the Slippery Rock Science and Technology Building calls for a 517 calendar day schedule. That consists of a 371 workday schedule that starts at the notice to proceed date, June 16, 2004 and ends on January 4, 2006. This project will be done just in time for the spring semester in the 2005-2006 school year. When the original schedule was discussed with the owner, they expressed that this project is long overdue. The pursuit of this project began in 1998 and the hope was to have the building by the Fall semester of 2002. Because of funding delays the projects design did not start until February of 2001. The University has long been awaiting this building and expressed a immediate need for students and faculty.

The purpose of this analysis is to achieve the building occupancy by the Fall semester of 2005. By accelerating the schedule and occupying the building an entire semester early, many people are pleased. First and most important the University has access to another facility. This facility allows for the much needed office space. This facility provides additional curriculums, which leads to student satisfaction. An additional semester for a student can increase their education significantly. This type of laboratory facility provides a much more hands on type of learning atmosphere. A type of learning atmosphere that is not easily possible in the existing Vincent Science Building. This existing building is very outdated and does not provide students with the type of technology needed in this
technology demanding world of education. Another aspect of the early construction date is University advertisement. With a brand new high technology facility, far more students are attracted to this University, increasing student enrollment. At the end of this analysis, it will be apparent that the cost is significantly increased, however with these types of benefits; this additional cost is well worth it.

To occupy the building a semester early this will require an acceleration of 96 work days. This will also allow for an extra week for University moving in. At first glance accelerating the schedule by 25% does not seem achievable, but by employing certain scheduling tactics this can be achievable. In this analysis, I will look at the buildings site layout and adjust it to improve work efficiency. I also plan on adjusting the schedule by overlapping, extra crews and additional shifts.

**Site Layout**

From discussions with several contractors at this site, it became a common occurrence that the site was too congested in certain areas, making work efficiency decrease. Often deliveries were delayed due to the fact that there was only one site delivery entrance. Trucks would literally have to wait in line. This congestion simply should not occur since there is ample space. When developing the site layout many factors were over looked. The main change I proposed for the site layout was to include two additional site entrances. This will prevent many of the problems currently occurring. Another change made was opening up the parking lot adjacent to the Spotts World Cultures Building. The University expressed that this parking area was used very infrequently because of the present construction. By occupying this added space for trailer’s and some contractor parking, some of the main congestion areas could be opened up for delivery lanes and material storage.

**Drawing/ Construction Documents/ Submittal Review**

Many construction management firms lately have increased the scope of their work by adding Document Review branches to their companies. The type of work performed by these companies is exactly what the name specifies, document review. Companies will take the completed drawings and look for many different things. First the company will check
for completeness. Often when architect firms are pressured to meet a deadline, several areas of the drawings are unclear or incomplete. These unclear sections result in countless RFI’s. Often these RFI’s become change orders. RFI’s and change orders can be very costly in terms of schedule especially with a DGS run project. This is because the process involves the changing of hands several times. An RFI must go from the contractor to the DGS site inspector. It then goes to the DGS site manager, who then relays it to the DGS project manager who then relays it to the architect. These steps can take weeks to get even simple answers. Change orders can take much longer. In a demanding construction schedule there is no time for these types of delays. By having a plan review, many of these RFI’s and change orders can be prevented. In addition to plan review, submittal review can also prevent delays. Because of the technology requirements and specifications, thousands of submittals will be processed. There is no way that all of these submittals will be checked. When submittals are not checked and equipment is delivered only to be rejected onsite, delays occur. By checking these submittals, costly delays can be prevented.

Another function of a submittal/ plan check activity could be an investigation of lead time materials. This type of investigation is not typically done but for this type of facility it could prove to be very important. Many times during construction the first several days specified for a particular process, the contractor will be waiting on material. This can be prevented by investigating what types of materials have longer lead times. In my experience casework, is often delayed because the order was not placed early enough to allow for the needed lead time. This building has a significant amount of casework.

Preventing schedule delay does not necessarily accelerate the schedule. When the present schedule was discussed with several contractors, time durations were often increased slightly about what is actually needed to allow for any changes and delays resulting from unclear documents. By clearing up the documents in advance, contractors can adjust their individual schedule accordingly.

**Additional Crew/ Shifts**

The addition of crews and shifts can prove to be quite costly when changed during construction. This analysis is looking at ways to accelerate schedule prior to bid. By
including in the project summary prior to bid the schedule duration, each contractor will need to assume each processes duration. This will cause contractors to assume extra crews. Adding extra crews increases cost and decreases duration. When calculating the extra cost associated, the cost of labor per day increases however the number of days decreases. The problem is however, that often two crews does not mean twice as much productivity so one cannot simply divide the duration in half and double the crew and the cost will even out. Rather the productivity level decreases and adding an additional crew decreases process duration by 40%. In many cases, contractors are very willing to double a crew in order to get in and out of a project faster to move on to another project. For them revenue is increased significantly from accelerated schedules.

**Key Schedule Reduction Areas**

In order to reduce the schedule by four months and not significantly increase the cost in every contract, I plan on concentrating on specific processes that occupy the majority of duration. To look at this schedule as a whole, the entire building is scheduled to take eighteen months. Ten of these eighteen months result in the basic superstructure alone. To reduce this duration by even 30%, a 3 month savings will occur. The whole idea of accelerating the schedule during interior work is that every trade is affected, leading to increased cost by all trades. To accelerate the schedule during the beginning of construction where only one or two trades are involved, will only increase the cost by one or two trades. Also, the earlier in the construction phase the less overlapping of activities. With this said, each activity has to wait until the activity is done beforehand. Initially the plumbing contractor will need to double its crew to install the necessary storm sewer and underground components. This three month process alone can save a little over one month. The cost association of doubling the crew size shows:

\[3 \text{ man crew} \times 8 \text{ hr work day} \times 60 \text{ day duration} = 1440 \text{ man hours}\]

\[3 \text{ man crew} \times 2 \text{ crews} \times 8 \text{ hr work day} \times 35 \text{ day duration} = 1680 \text{ man hours}\]
Assuming an average labor cost per hour at $30 the added crew only results in a $7200 increase in cost plus the cost of extra equipment.

The foundation system affects only the general contractor. The foundation system is also a three month process. By doubling its crew and equipment, the foundation schedule can also be reduced by a little over one month. These crews instead of working from left to right, will now start at each end and work their way in. Added crews require additional coordination. However, at this point only the two crews will be working on site, so this should not be a problem. The cost of adding this crew can be seen below:

\[ 6 \text{ man crew} \times 8 \text{ hr work day} \times 60 \text{ day duration} = 2880 \text{ man hours} \]

\[ 6 \text{ man crew} \times 2 \text{ crews} \times 8 \text{ hr work day} \times 35 \text{ day duration} = 3360 \text{ man hours} \]

Assuming an average labor cost per hour at $30 the added crew only results in a $14,400 increase in cost plus the cost of extra equipment.

By simply altering two contractors in less than five percent of their total work, over two months have been saved. Another process that can be significantly shortened is steel erection. Presently there is one crane used on site and it relocates to three separate spots during erection. The entire duration of this activity is 64 work days, a calendar duration of 3 months. If this activity was altered to include the use of 2 cranes and 2 crews this activity as well could be reduced by yet another whole month plus a week. The cost of this addition is the same as the foundation crew addition plus the cost of the extra crane. The cost per crane be assumed at $1000/day per crane. So the added crane will result in an added cost of $10,000. The cost of the added equipment above for the foundation and underground plumbing can be assumed at another total addition of $8000.

In nine months worth of schedule, already from only 3 processes, over 3 months of schedule have been eliminated and at a combined added cost of $54,000. This price will prove to be quite an inexpensive tradeoff with an entire added semester of occupancy.
Of course these three activities alone will reduce schedule by three months and three weeks, however due to the initial and small overlapping, the schedule reduction will be assumed to be only three months, which is one month shy of the necessary reduction of four months. To cut out another month each other contractor could be expected to accelerate their schedule by 10%. This is a very minimal increase can be explained below.

8 man electrical crew x 9 months work (180 days) x 40 hrs a week x $30/ hr  
= $1,728,000

9 man electrical crew x 8.2 months work (162 days) x 40 hrs a week x $30/ hr 
= $1,749,600

By assuming that adding 10% more members to a crew, that results in a 10% reduction in schedule, a cost increase of 1.3% can be assessed to the cost of labor.

**Conclusion**

To conclude this analysis, the reduction of the schedule was extremely easy and cost efficient to do at the beginning processes in construction when the activities do not have overlap. I was able to reduce the schedule by three months while at the same time adding only $54,000. An additional cost of roughly $100,000 can be assessed from the calculated 1.3% cost increase from a 10% reduction in schedule from each other trade. That brings a grand total of $154,000 to reduce the schedule four months. This total is very low in the owners point of view because of the enormous benefits of occupying the building an entire semester early.