The Mutum-Parana II Bridge project (A)

1. Introduction

The second longest river in South American after the Amazon, the Parana River joins with the Paraguay and Uruguay River before emptying into the Ro de la Plata estuary on its way to the Atlantic Ocean. The river begins its 3,032-mile (4,879-Km) course in east-central Brazil. The Parana flows mainly among high plateaus through Paraguay and Argentina.

The Brazilian company Curitiba Pontes Ltd. was awarded for the construction of the Mutum-Parana II Bridge over the river Parana. The river Parana in Argentina is the last obstacle in a big highway construction project. This highway was a promise from the government to poor people of the interior to link their region to Buenos Aries. Therefore, large investments were made to stimulate the economy.

2. The Team Meeting

Jose Silva Coelho, the manager of this project, was very pleased with the announcement and called an early morning meeting to share his preliminary thoughts with his team. While Carlos and Orlando were looking carefully at the technical details of the project, Jose eagerly opened the meeting. He was confident that the company should be able to start at the beginning of the year (January 2nd, 2012) in order to meet the deadline. Although a specific deadline was not yet negotiated, Joes believed that the project should be finished at the end of February 2013 (February 25th, 2013). He believed that a weekly penalty clause of Rs12, 00,000 would be reasonable and realistic estimate.

Carols Garez has been working as a construction engineer for 10 years for the same company. He knew that the unstable ground may cause severe delays. The Parana had some very unstable river banks because of the swirling water. He estimated that the chance of the ground being unstable at both sides was 50%. Extra stabilization activities would then be needed, leading to a severe increase of the preparatory work (activity 1). The stabilization of these river banks would take 10 extra weeks if the river banks mainly consisted of clay (70%), but could go up to 15 weeks if the river banks consisted of quicksand (30%).

Maria Mota Pereira, the accounts manager of Curitiba Pontes Ltd., was surprised by the early start proposal of Jose, but quickly realized that he would not tolerate any start delay whatsoever. Therefore, she decided to warn the whole team for a possible cost increase for the total mobilization, excavation and demobilization activities (activities 2 to 16). Since there is a small chance (1 out of 15) that cranes, needed to perform these activities, and may be released from another project by the end of Aril. She proposed to delay the project till then.

Orlando Carvalheiro, the resource manager of the company, was also aware that Jose would not tolerate any delay replied that this extra mobilization cost would not lead to severe cost increases, as long as this resource constraint was carefully taken into account. Maria replied that

alternative machines to temporarily replace the unavailable cranes until the end of April would cost Rs20, 000 per week. Orlando was not pleased with that limitation about the resources, and interrupted by saying that other cost considerations were also important. He immediately mentioned the overhead expense of Rs20, 000 per week that would be incurred in case of any project delay.

The technical details of the project are given in the next subsection of this case.

3. The Project

The bridge is a composite steel-concrete construction for a highway spanning a river and a small ravine. It consists of a concrete paving slab supported by seven steel girders that are placed on three reinforce concrete abutments. The river flows on the right-hand side between 2 and 3. Each of the abutments rests on a heavy concrete footing supported by steel piles in the ground. A steel guardrail is mounted on each side of the bridge. Figure 1 shows the highway bridge profile with the three abutments (two outside abutments and one middle abutment). Figure 2 displays a cross section of the highway bridge, showing the various steel girders.

First, some preparatory work (activity 1) has to be performed and the equipment has to be moved into place. As soon as the necessary preparation have been performed (6 week after the start of activity 1) the mobilization of the of the pile rigs 1, 2, and 3 (activity 2, 3 and 4) can be started together with the excavation of the abutment 1, 2 and 3 (activity 5, 6 and 7). The mobilization of the pile can be done in 1 week; the excavation of the abutments 1 and 3 will take 4 weeks. The excavation of the abutment 2 will need 6 week to complete. When the excavations are completed, the piles can be driven into the ground. This job can be done in 1 week for piles 1 and 3 (activity 8 and 9). The middle pile (activity 9) will need an extra week to complete.

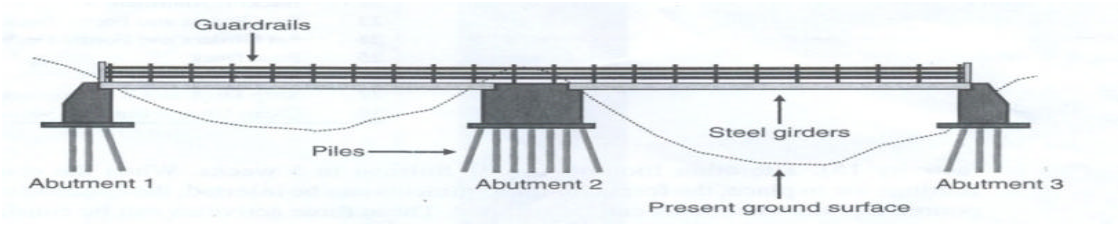


Fig.1 The highway bridge-profile

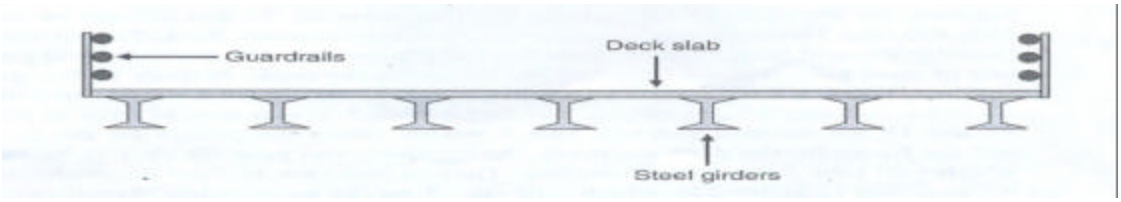


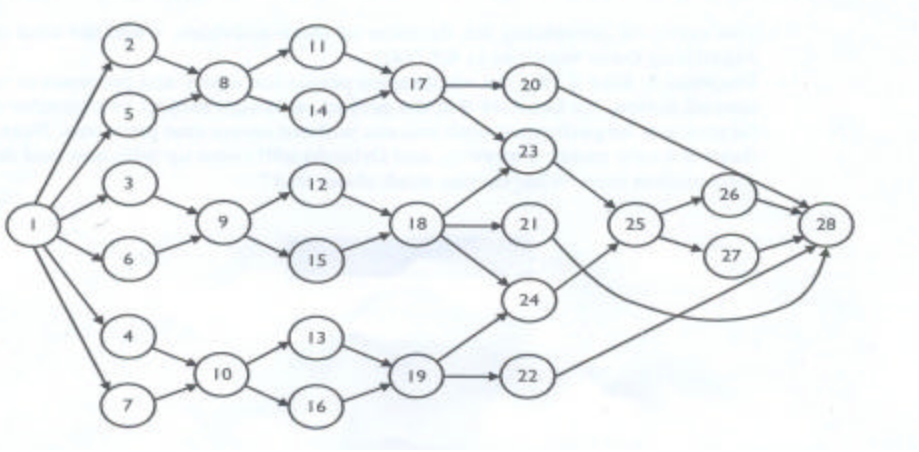
Fig. 2 The highway bridge – cross section

Table 1 The project activities for the Mutum-Parana II bridge project (a)

ID	Activity description
1	Preparatory Work and Move in
2	Mobilize Pile Rig 1
3	Mobilize Pile Rig 2
4	Mobilize Pile Rig 3
5	Excavate Abutment 1
6	Excavate Abutment 2
7	Excavate Abutment 3
8	Drive Piles Abutment 1
9	Drive Piles Abutment 2
10	Drive Piles Abutment 3
11	Demobolize Pile Rig 1
12	Demobolize Pile Rig 2
13	Demobolize Pile Rig 3
14	Forms, Pour and Strip Footing 1
15	Forms, Pour and Strip Footing 2
16	Forms, Pour and Strip Footing 3
17	Forms, Pour and Strip Abutment 1
18	Forms, Pour and Strip Abutment 2
19	Forms, Pour and Strip Abutment 3
20	Backfill Abutment 1
21	Backfill Abutment 2
22	Backfill Abutment 3
23	Set Girders and Forms Deck 1-2
24	Set Girders and Forms Deck 2-3
25	Pour Deck
26	Saw Joints
27	Strip Deck and Rub Concrete
28	Clean Up and Final Inspection

Next, the pile rigs can be demobilized and removed (activities 11, 12 and 13). This will take 1 week. At the same time, the company can start to make the concrete footing (activities 14, 15 and 16). Each activity includes the delivery of the forms for the concrete footing, the pouring of the concrete and the striping of the footing. The footing between the river and the ravine will take 7 weeks to complete (activity 15). The other footing will be finished in 5 weeks. When the concrete footings are in place, the forms for the abutments can be inserted, the concrete can be poured and the abutment can be stripped. These three activities can be considered as one activity

for each abutment. For the outside abutments (activity 17 and 19) this will take 7 weeks. The middle abutment will take 10 weeks to be finished. Once finished, the backfilling of the abutments (activities 20, 21 and 22) can be started. This will take 3 weeks to complete for the outside abutments. Backfilling abutment 2 (activity 21) will take 5 weeks. Between the 3 abutments, the company will put two sets of steel girders and will install the forms for the deck. Activity 23 (set girders and forms deck 1-2) can start as soon as activity 17 and 18 are finished and will take 6 weeks. Activity 24 (set girders and forms deck 2-3) can start as soon as activity 18 and 19 are finished and will take 8 weeks. When the girders are put in place and the forms for the deck are ready, the company can pour the deck (activity 25), which will take 2 weeks to complete. Then, it can start to strip the deck and rub the concrete (activity 27), which will take 5 weeks to complete. Simultaneously, the joints can be sawed (activity 26), which can be finished in 4 weeks. The last activity is the clean up and final inspection (activity 28).



This job will take 7 weeks and can only start after the backfilling of the abutments is finished. Moreover, it is necessary that activity 26 (saw joints) and activity 27 (strip deck and rub concrete) are completed. The detailed description and the technological successive relations are indicated in table 1 and fig 3. All precedence relations are assumed to be minimal finish-start relations with a time-lag of zero.

4. The Team Proposals

Five proposals were submitted by the members of the team. A wrap-up meeting will be scheduled next week to decide the best alternative to cope with situation:

- Proposal 1: Orlando knows that the activity "strip deck and rub concrete (27)" can be expatiated by the use of sophisticated machines. Using this machine would decrease the activity duration from 5 weeks to 2 weeks, at an additional total cost of Rs.8000.

- Proposal 2: Maria proposes to have the duration of any of the "excavations of the abutments (5, 6 and 7)" activities, which costs the company Rs.40, 000 per abutment.

- Proposal 3: The activity “forms, pour and strip abutment 2 (18)” can be expedited by the help of extra pile driver men and equipment operators, the minimal duration is 5 weeks, at an additional cost of Rs4, 00, 000 per week.

- Proposal 4: An option proposed by the whole team is to expedite the “backfilling of the abutments (20, 21 and 22)” to 50% of the original duration. Would you agree on decreasing the duration of these activities, when the total cost of expediting these activities is Rs4, 00, 000?

- Proposal 5: Jose thinks the whole team panics too easily and proposes to take no special action. He believes that the project, although subject to a number of risk factors, can be performed with success without severe cost problems. Next week, there is a new meeting anyway, and Orlando will come up with new and detailed information then. What do you think about that?