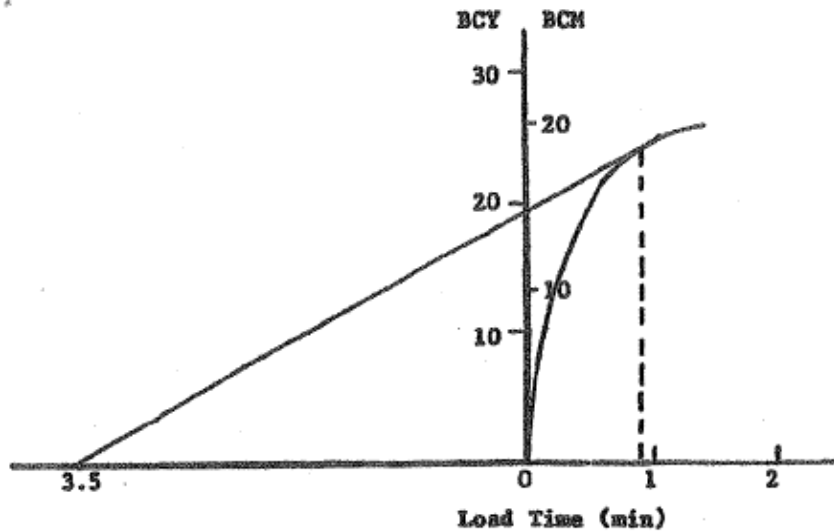**CIE600 Construction Methods**
Homework#3 - Solution

1)

Plot load growth curve:

From the load growth curve, for a cycle time less load time
of 3.5 min the optimum load time is 0.9 min.

2)

Blade load = 10 LCY (7.65 LCM)

Fixed cycle time = 0.15 min   (Table 4-4)

$$\text{Haul time} = \frac{95}{1.5 \times 88} = 0.72 \text{ min}$$

$$[= \frac{29.0}{2.4 \times 16.7} = 0.72 \text{ min }]$$

$$\text{Return time} = \frac{95}{5 \times 88} = 0.22 \text{ min}$$

$$[= \frac{29.0}{8.1 \times 16.7} = 0.22 \text{ min }]$$

Cycle time = 0.15 + 0.72 + 0.22 = 1.09 min

$$\text{Production} = 10 \times \frac{60}{1.09} \times 0.83 = 457 \text{ LCY/h}$$

$$[= 7.65 \times \frac{60}{1.09} \times 0.83 = 350 \text{ LCM/h}]$$

3)

```
Bucket fill factor (average) = 0.95                    (Table 3-2)

Bucket volume = 4.0 x 0.95 = 3.8 LCY

          [ = 3.06 x 0.95 = 2.91 LCM ]

Basic cycle time = 0.35 min (loose)                    (Table 4-6)

Effective grade = 120 = 6%                             (Eq 4-7)
                  20

          [ = 60 = 6% ]
            10

Travel time = 0.5 min                                  (Fig 4-14)
```

(In this problem, we are considering loose gravel.)

4)

```
Load time = 12 x 60 = 2.4 min
            300

       [ = 9.2 x 60 = 2.4 min ]
         229

 a. N = 8.0 + 2.0 + 2.4 = 5.2 = 6                       (Eq 4-16)
        2.4

 b. Since n = N

    Production = 300 x 0.80 = 240 BCY/h

          [ = 229 x 0.80 = 183 BCM/h ]

 c. Unit cost = 40 + (6 x 20) = $0.67/BCY               (Eq 2-2)
                240

       [ = 40 + (6 x 20) = $0.87/BCM ]
         183
```

5)

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Coefficient of traction = 0.60                         (Table 4-2)

Maximum usable pull = 0.60 x 38720 = 23,232 lb        (Eq 4-9)

                [ = 0.60 x 17563 = 10 538 kg ]

Let X = grade


Grade resistance = X x 70400 = 70400 X                 (Eq 4-6)

                [ = X x 31933 = 31933 X ]

Rolling resistance = 100 x 70400 = 3520 lb
                              2000

                [ = 50 x 31933 = 1597 kg ]
                         1000

Total resistance = 70400 X + 3520

                [ = 31933 X + 1597 ]

Set total resistance equal to usable pull

        70400 X + 3520 = 23232

      [ 31933 X + 1597 = 10538 ]

                    X = 0.28

              Grade = 28%
```