The CAL Company produces a line of luggage goods. The typical distribution plan is to produce a finished-goods inventory located at the plant site. Goods are then shipped to company-owned field warehouses by way of common carriers. Rail is currently used to ship between the East Coast plant and a West Coast warehouse. The average transit time for rail shipments is T = 21 days. At each stocking point, there is an average of 100,000 units of luggage having an average value of C = $30 per unit. Inventory-carrying costs are I = 30 percent of unit inventory value per year.

The company wishes to select the mode of transportation that will minimize total costs. It is estimated that for every day that transit time can be reduced from the current 21 days, average inventory levels can be reduced by 1 percent, which represents a reduction in safety stock. There are D 700,000 units sold per year out of the West Coast warehouse. The company can use the following transport services:

Transport Service	Rate, $/Unit	Door-to-Door Transit Time, Days	No. of Shipments per Year
Rail	0.10	21	10
Piggyback	0.15	14	20
Truck	0.20	5	20
Air	1.40	2	40

Procurement costs and transit-time variability are assumed negligible.

A diagram of the company's current distribution system is shown in Figure 7-1. By selecting alternate modes of transportation, the length of time that inventory is in transit will be affected. The entire annual demand (D) spends some time in transit; this fraction of the year is represented by T/365 days, where T is the average transit time in days. The annual carrying cost of this in-transit inventory is ICDT/365.

The average inventory at both ends of the distribution channel can be approximated as Q/ 2, where Q is the shipment size. The holding cost per unit is I x C, but the item value C must reflect where the inventory is in the channel. For example, the value of C at the plant is the price, but at the warehouse, it is the price plus the transportation rate.

The transportation rate applies to the annual demand such that R x D represents the total annual transportation cost. Calculate these four relevant costs for each transport choice. Trucking offers the lowest total cost, even though rail transport offers the lowest rate and air transport offers the lowest inventory cost. With trucking, transit time can be reduced to five days, and the inventory levels at each end of the channel can be reduced by 50 percent.

Question

Please show total cost calculation to select the best alternative as minimizing total cost.