COST ANALYSIS OF FISH CONTAINING TANKS

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PREFACE

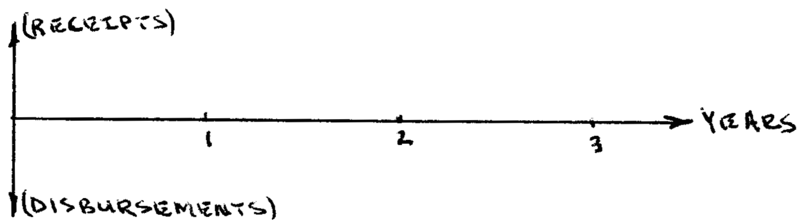
Engineers are confronted with two important interconnected environments, the physical and the economic. Their success in altering the physical environment to produce products and services depends upon a knowledge of physical laws. However, the worth of these products and services lies in their utility measured in economic terms. There are numerous examples of structures, machines, processes, and systems that exhibit excellent physical design but have little economic merit.

All decision criteria to be considered must incoporate some index, measure of equivalence, or basis of comparison that summarizes the significant differences between investment alternatives. The reduction of alternatives to a common base is necessary so that apparent differences become real differences, with the time value of money considered. When expressed in terms of a common base, the real differences become directly comparable and may be used in decision making. The bases of comparison used are the present-worth amount (PW) and the annual equivalent amount (AE).

The present-worth amount has a number of features that makes it suitable as a basis of comparison. First, it considers the time value of money according to the value of i (interest rate) selected for the calculation. Second, it concentrates the equivalent value of any cash flow in a single index at a particular point in time (t=0). Third, the value of the present worth amount is always unique no matter what may be the investments cash flow pattern. That is, any sequence of receipts and disbursements will give a unique present worth amount for a particular value i.

The annual-equivalent amount (AE) was used only to correct the discrepancy between the different economic life spans of each alternative and made it into a common life span using a common multiple of years. This makes it possible to use the present worth equation and obtain a common base for decision making.

To aid in identifying and recording the economic effects of alternative investments, a graphical description for each alternative's cash transactions may be used. This pictorial discriptor, referred to as a cash flow diagram, will provide all the information necessary for analyzing an investment proposal.



The cash flow diagram represents any receipts received over a period of time as an upward arrow (an increase in cash) located at the period's end. Similarly, the disbursements are represented by a downward arrow (a decrease in cash). These arrows are then placed on a time scale representing the duration of the proposal.

Analysis in Brief

The following alternatives ~~were~~ will be considered in the final analysis: the following (letters ~~were~~ will be attached to each alternative)

Alternative

A	Concrete
B	Wood
C	Steel Commercial Pool (Doughboy Pool)
D	Aluminum

All pools ~~were~~ will be based on a uniform size (24' diameter, 4' high), and considered over a 12 years life span.

Definitions:

i : interest rate

n : number of years

PW : present worth

AE : annual equivalence

(P/A i, n) : equal payment series present-worth factor; this factor may be used to find the present worth (P) of a series of equal annual payments (A).

(A/F i, n) : sinking fund factor; this factor may be used to find the required year-end payments (A) to accumulate a future amount (F).

(A/P i, n) : equal-payment series capital-recovery factor; this factor may be used to find the year-end payments (A) that will be proveded by a present amount (P).

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Introduction

Working (part time) as a lab technician at the National Fisheries Service in Kewalo Basin, I was asked to do a cost analysis of the possible alternatives for fish containing tanks. This will only be a general analysis to determine which alternative is most feasible.

Problem

These tanks will be designed to keep salt water specimens and are circular with a diameter of 24 feet and depth of 4 feet. They will be built on existing ground surface which means the walls must be rigid and able to resist tensile stresses and over turning. A vinyl plastic will be fitted inside the tank. Therefore the exterior shell is our focal point. This shell must be durable; salt water and weathering are the predominant factors which will affect the shell life.

Constraints

1) Interest Rate (i): A 6% interest rate will be used because it is the interest rate for banks.

2) Cost: No budget restraint will be imposed. This is a general overview of the different types of alternatives and a very liberal budget will be considered.

3) Inflation: No inflation factor will be considered.

4) Life of Analysis: The analysis will be looked over a 12 years span.

5) Unequal Service Lives: The method that will be used to estimate future alternatives will be the assumption that an investment

opportunity will be replaced by an identical alternative until a common multiple of lives is reached.

Development of Alternatives

The following alternatives were based on the accessibility of materials. The following materials were considered initially:

Concrete
Wood
Steel (galvanized)
Fiberglass (Alsynite)
Aluminum
Brick

The present set up are commercially made galvanized steel tanks therefore a do-nothing alternative will not be considered.

After talking to Andy Kulgis who tried using Alsynite for similar purposes, I realized this material would not be feasible. The durability of the material is insufficient due to the type of usage our tanks would under go. We also tried using aluminum but had some unfortunate experiences-a couple tanks blew apart due to fatigue of the material. This is from filling and emptying the tank for periodic cleaning. I eliminated brick construction because of its poor strength in handling tensile stresses which will result from hydrostatic pressure. Therefore the following table lists the alternatives that will be considered;

Initial Cost:

Construction Materials	Amount	Alternatives A	B	C	D
*Stainless Steel Bands	$24.09/ 100 ft.	-	$72.27	-	-
Vinyl plastic Liners	1	$150	150	150	150
*Stainless Steel Buckles	$18.15/ 100	-	18.15	-	-
*Plywood Sheets	$11.00/ sheet	-	110.00	-	-
*Bolts	$2.31/ 100	-	2.31	-	-
*Nuts	$1.03/ 100	-	1.03	-	-
*Washers	$5.13/ 5 lbs.	-	5.13	-	-
Water Seal	$8.18/ gallon	-	16.36	-	-
Tar	$3.95/ gallon	-	7.90	-	-
Total		$150	$383.15	$150	$150

* Prices relate to bulk quantity of material which only a portion is utilized.

Note: Commercial prices for following pools;

Concrete = $6975.00
Steel = $400.00
Aluminum = $400.00

Initial Labor Cost (Installation):

Discription	A	B	C	D
Installation 6 people @ $5.00/hr.	-	-	90.00	90.00
Treatment of wood (2 coats water seal) 4hr. @ $5.00/hr.	-	20.00	-	-
Paint tar and assemble 16 hr. @ $5.00/hr.	-	80.00	-	-
Set up 2 hr. @ $5.00/hr,	-	10.00	-	-
Band installation 2 hr. @ $5.00/hr.	-	10.00	-	-
Total	-	$120.00	$90.00	$90.00

Labor Cost to Remove:

2 people @ $4.50/hr.	-	36.00	36.00	36.00
Total	-	$36.00	$36.00	$36.00

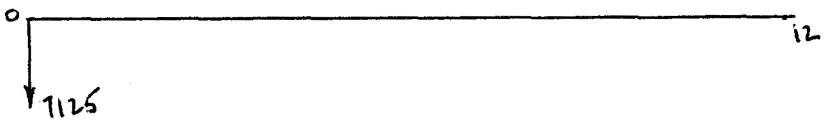
TABLE

Alternatives	Initial Cost	Initial Labor Cost	Life (years)	Salvage Value	Annual Maintan.	Labor Cost to Remove	Cost to Remove
A Concrete	7125.00	-	-	-	-	-	-
B Wood	383.15	120.00	3	-	-	36.00	5.00
C Doughboy (Steel)	550.00	90.00	2	-	-	36.00	5.00
D Aluminum	550.00	90.00	3	30.00	-	36.00	5.00

Note: Assume materials will last the estimated life without malfunctioning, which would produce maintainence cost. Therefore the operation and maintainence cost will be constant for all the given alternatives and entails such things as periodic cleaning.

Economic Analysis of Alternatives:

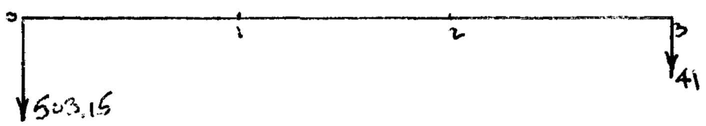
Alternative A



$PW(6\%)_A = \$7125.00$

Alternative B

(A/P 6,3)=.3741
(A/F 6,3)=.3141
(P/A 6,12)=8.3839



$PW(6\%)_B = 201.11\ (P/A\ 6,\ 12) = \$1686.06$

$AE(6\%)_B = 503.15\ (A/P\ 6,\ 3) + 41\ (A/F\ 6,\ 3) = 201.11$

Alternative C

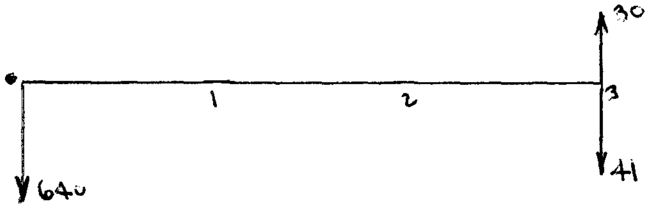
(A/P 6,2)=.5454
(A/F 6,2)=.4854

$AE(6\%)_C = 640(A/P\ 6,\ 2) + 41(A/F\ 6,\ 2) = 368.96$

$PW(6\%)_C = 368.96(P/A\ 6,\ 12) = \$3093.30$

Alternative D

(A/P 6,3)=.3741
(A/F 6,3)=.3141



$AE(6\%)_D = ((640-30)(A/P\ 6,3)+30(.06))+41(A/F\ 6,3)=242.88$

$PW(6\%)_D = 242.88(P/A\ 6,\ 12)=\$2036.27$

Decision Making

Using the assumption that an investment will be replaced by an identical alternative until a common multiple of lives is reached tends to overstate the differences between the alternatives. This is due to the assumption that the differences will occur over a time span that exceeds the service lives of the current alternatives. It is infrequent that a sequence of alternatives will repeat themselves since technological progress can lead to improved alternatives in the future. However it is necessary to make certain assumptions about the service interval so that the techniques of decision making are applicable. I used a 12 year interval because in general the longer the study period the more significant the results.

Alternative D (Aluminum) should actually be eliminated entirely from consideration because of reasons discussed earlier.

Comparing these four alternatives we can conclude that alternative B (wood) would be the most feasible and cost effective.

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Kulgis, A. Director of Aquatic Farms

Vinyl Pools of Hawaii

Williams, J. Vice President of Paddock Pools