ENGINEERING ECONOMY

Depreciation & Income Tax

Definition

"Loss of value for a fixed/current asset"

- Current assets are balance sheet accounts that represent the value of all assets that can reasonably expect to be converted into cash within one year.
- Current assets are important to businesses because they can be used to fund day-to-day operations and pay ongoing expenses.

Why Do We Consider Depreciation?

Business Expense: Depreciation is viewed as a part of business expenses **that reduce taxable income.**

Gross Income -Expenses:

(Cost of goods sold)

(Depreciation)

(operating expenses)

Taxable Income

- Income taxes

Net income (profit)

Depreciated Assets

- Assets **used in business** or held for production of income
- Assets having a **definite useful life** and a life **longer than one year** (you can never depreciate land)
- Assets that must **wear out**, become obsolete or lose value

Depreciated Assets

A qualifying asset for depreciation must satisfy **all of the three conditions above.**
Ex: buildings, machinery, equipment, vehicles etc.

The depreciated assets are **not valid to inventory or stock sale, or investment property.**

Terms in Depreciation

- Useful life – how many years will an asset be useful to a company?
- Salvage value – Asset's estimated value at the end of its useful life. 10% rule of the initial value
- Book value BVt - Remaining undepreciated capital investment in year t

Depreciation Method

Straight of Line Depreciation (SLD)	Sum of Years Digits Depreciation (SOYD)	Double Declining Balance Depreciation (DDBD)
Amount of depreciation **cost is equal annually**	Amount of depreciation **cost isn't equal annually** - Based on sum of years digit	- Amount of depreciation **cost isn't equal annually**
Annual Depreciation: $SLD = \frac{1}{N}(I - S)$ N = useful life (recovery period) I = investment S = salvage value	Annual depreciation: $SOYD_t = \frac{N-(t-1)}{\sum \text{digit}}(I - S)$ $\sum \text{digit} = \frac{N}{2}(N+1)$ N = useful life (recovery period) t = period (year t)	$DDBD_n = \frac{2I}{N}(1-\frac{2}{N})^{n-1}$ $BV_n = I(1-\frac{2}{N})^n$ N = useful life (recovery period) I = investment

Straight of Line Depreciation (SLD)

- Travel agent has mini bus Rp 150 million. The useful life of the minis bus is 5 years and it can be sold Rp 50 million at the end of its life.
- Estimate **the annual depreciation**
- Total of 3 years depreciation
- Book value after three years usage using SLD method

Answer

- Annual depreciation:

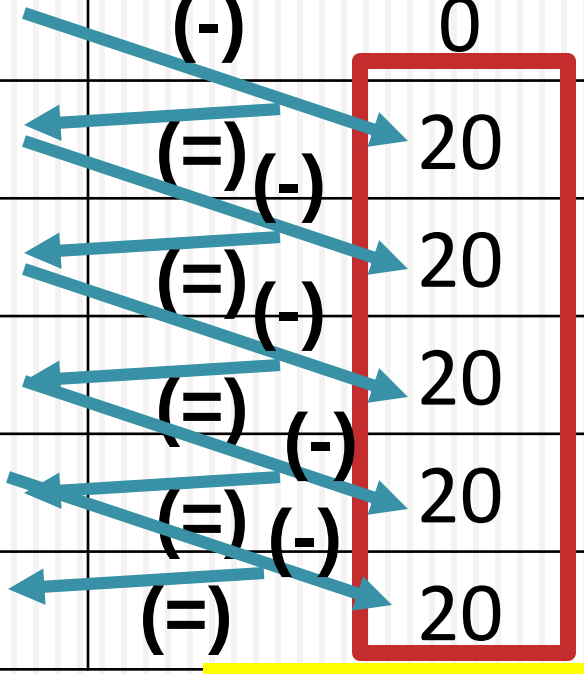
$$SLD = \frac{1}{N}(I - S)$$

$$SLD = \frac{1}{5}(150 - 50)$$

SLD = Rp 20 million/years

Apply to the table

Years t-	Book value	Depreciation 1/N (I-S)		$\sum Dep_t$
0	150	(-)	0	0
1	130	(=)	20	20
2	110	(=)	20	40
3	90	(=)	20	60
4	70	(=)	20	80
5	50	(=)	20	100



book value = salvage then → STOP !

- Total of depreciation cost after 3 years usage:
- $\sum Dep_t = \frac{t}{N}(I - S)$
- $\sum Dep_3 = \frac{3}{5}(150 - 50)$
- $\sum Dep_3$ = Rp 60 Million

- Book value at the end of year 3 :

$BV_3 = I - \sum Dep_{\ 3}$

$BV_3 = 150 - 60$

$BV_3 = 90$ juta

Sum of Years Digits Depreciation (SOYD)

- Travel agent has mini bus Rp 150 million. The useful life of the minis bus is 5 years and it can be sold Rp 30 million at the end of its life.
- Remarks :

  Investment(I) = Rp 150 milion

  salvage value(S)= Rp 30 milion

  useful life (N) = 5 years

The first step for SOYD method

Calculate the value of digit!

- $\sum$ digit = $\frac{N}{2}(N+1)$
- $\sum$ digit = $\frac{5}{2}(5+1)$
- $\sum$ digit = 15

Calculate annual depreciation

$$\text{SOYD}_t = \frac{N-(t-1)}{\sum \text{digit}} (I - S)$$

$$t = 1 \rightarrow \text{SOYD}_t = \frac{5-(1-1)}{15} (150 - 30) = \frac{5}{15} (120) = 40$$

$$t = 2 \rightarrow \text{SOYD}_t = \frac{5-(2-1)}{15} (150 - 30) = \frac{4}{15} (120) = 32$$

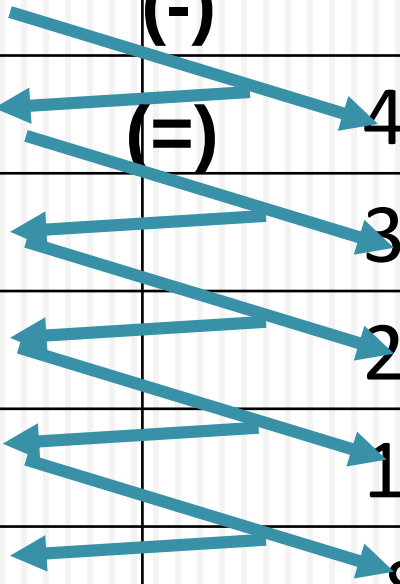
$$t = 3 \rightarrow \text{SOYD}_t = \frac{5-(3-1)}{15} (150 - 30) = \frac{3}{15} (120) = 24$$

$$t = 4 \rightarrow \text{SOYD}_t = \frac{5-(4-1)}{15} (150 - 30) = \frac{2}{15} (120) = 16$$

$$t = 5 \rightarrow \text{SOYD}_t = \frac{5-(5-1)}{15} (150 - 30) = \frac{1}{15} (120) = 8$$

Apply to the table

N	BV	SOYD	∑ *Dep*
0	150	(-)	
1	110	(=) 40	40
2	78	32	72
3	54	24	96
4	38	16	112
5	30	8	120



book value = salvage then → STOP !

Now if we use DDBD method

- Remarks :

  Investment(I) = Rp 150 milion

  salvage value(S)= Rp 30 milion

  useful life (N) = 5 years

$$DDBD_n = \frac{2I}{N}\left(1-\frac{2}{N}\right)^{n-1}$$

$$DDBD_1 = \frac{2(150)}{5}\left(1-\frac{2}{5}\right)^{1-1} = 60$$

$$DDBD_2 = \frac{2(150)}{5}\left(1-\frac{2}{5}\right)^{2-1} = 36$$

$$DDBD_3 = \frac{2(150)}{5}\left(1-\frac{2}{5}\right)^{3-1} = 21{,}6$$

$$DDBD_4 = \frac{2(150)}{5}\left(1-\frac{2}{5}\right)^{4-1} = 12{,}96$$

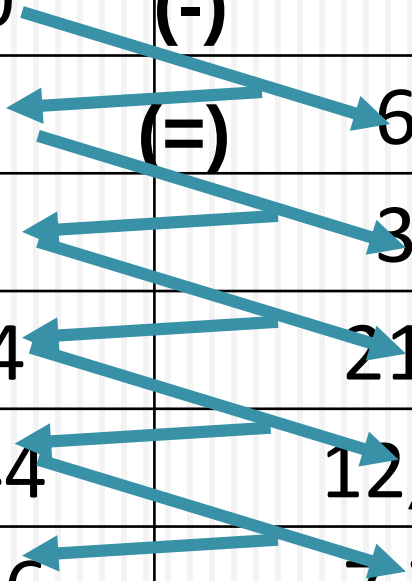
$$DDBD_5 = \frac{2(150)}{5}\left(1-\frac{2}{5}\right)^{5-1} = 7{,}776$$

$$BV_n = I\left(1-\frac{2}{N}\right)^{n}$$

$$BV_5 = 150\left(1-\frac{2}{5}\right)^{5} = 11{,}66$$

Apply to the table

N	BV	DDBD	∑ *Dep*
0	150	(-)	
1	90	(=) 60	60
2	54	36	96
3	32,4	21,6	117,6
4	19,44	12,96	130,56
5	11,66	7,78	138,34



book value ≠ salvage value

Book Value Problem

- DDBD→if we using this method

“ book value ≠ salvage value”

- If Book value$_{t=n}$ **>** salvage value→**problem**

  If Book value$_{t=n}$ **=** salvage value then **OK**

  If Book value$_{t=n}$ **<** salvage value then **OK**

Some nations permits zero residual value (the smallest value)

Book Value Problem

Book value$_{t=n}$ > salvage value
"it will be sunk cost and must be avoided"

- How to solve this problem→
  1. **Continue the calculation of depreciation using 2 methods DDBD and SLD**
  2. **However you have to change SLD formula into this:**

$$SLD_t = \frac{1}{N-(n-1)}(BV_{t-1} - S)$$

Book Value Problem

$$SLD_t = \frac{1}{N-(n-1)}(BV_{t-1} - S)$$

- N-(n-1) = remaining recovery period
- BV_{t-1} = book value from previous year using DDBD method

Book Value Problem

1. Continue the calculation of depreciation using 2 methods DDBD and SLD
2. Select larger depreciation amount
3. When SLD ≥ DDBD, the switching is conducted

Practice Problem

- Travel agent has purchased second bus worth to Rp 700 million. The useful life of the bus is 5 years and it can be sold Rp 30 million at the end of its life.

- Remarks :

  Investment(I) = Rp 700 milion

  salvage value(S)= Rp 30 milion

  useful life (N) = 5 years

Answer

- Investigate the book value at the end of period

$$BV_n = I(1-\frac{2}{N})^n$$

$$BV_5 = 700\,(1-\frac{2}{5})^5 = 54{,}432$$

- **Book value > salvage value-→DDBD to SLD**

One by one step DDBD to SLD

t	$SLD_t = \frac{1}{N-(n-1)}(BV_{t-1} - S)$	$DDBD_n = \frac{2I}{N}\left(1-\frac{2}{N}\right)^{n-1}$	$BV_n = I\left(1-\frac{2}{N}\right)^{n}$	remarks
0			700	
1	$\frac{1}{5-(1-1)}(700-30) =$ 134	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{1-1} =$ **280**	420	DDBD
2	$\frac{1}{5-(2-1)}(420-30) =$ 97,5	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{2-1} =$ **168**	252	DDBD

DDBD to SLD conversion

t	$SLD_t = \frac{1}{N-(n-1)}(BV_{t-1} - S)$	$DDBD_n = \frac{2I}{N}\left(1-\frac{2}{N}\right)^{n-1}$	$BV_n = I\left(1-\frac{2}{N}\right)^{n}$	Remarks
0			700	
1	$\frac{1}{5-(1-1)}(700-30) = 134$	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{1-1} = 280$	700-280= 420	DDBD
2	$\frac{1}{5-(2-1)}(420-30) = 97.5$	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{2-1} = 168$	420-168= 252	DDBD
3	$\frac{1}{5-(3-1)}(252-30) = 74$	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{3-1} = 100.8$	252-100.8=151.2	DDBD
4	$\frac{1}{5-(4-1)}(151.2-30) = 60.6$	$\frac{2(700)}{5}\left(1-\frac{2}{5}\right)^{4-1} = 60.48$	151.2-60.6= 90.6	Switch to SLD
5	$\frac{1}{5-(4-1)}(151.2-30) = 60.6$	-----	90.6-60.6=30	Switch to SLD

Depreciation comparison

- DDBD and SLD is commonly used in Indonesia except SOYD
- DDBD is recommended if you want to find income after tax
- SOYD and DDBD are suitable for asset which the deterioration or loss the value is very quick

  e.g: production machine

Excel Function

- **SLD**

=SLN(cost, salvage, life)

- **SOYD**

=SYD(cost, salvage, life, period)

- **DDBD**

=DDB(cost, salvage, life, period [factor])

- **DDBD conversion**

=DDB(cost, salvage, life, start_period,End_period,[factor], [no _switch])

- Factor default 200%/N

After Tax Cash Flow

Taxable income= ∑ income– interest– Depreciation

Tax= taxable income x tax rate (%)

After Tax Cash Flow= Before Tax Cash Flow– tax

The more amount depreciation cost, the less taxable income and of course the tax as well

Practice Problem

investment	Rp 700 million
Annual Benefit	Rp 130 million
Annual Cost	Rp 30 million
Over haul$_{(t=5)}$	Rp 70 million
Salvage value	Rp 300 million
Useful life	8 years
Corporate tax	10% per years

"how much will the corporate pay in income taxes for the year using SLD and DDBD?

SLD Method

n	Before tax cash flow			SLD = 1/N (I-S)	Taxable income	tax 10 %	After tax cash flow
	(-)	(+)	NCF				
(a)	(b)	(c)	(d=c-b)	(e)	(f=d-e)	(g=fx10%)	(h=d-g)
0	700		-700				-700
1	30	130	100	50	50	5	95
2	30	130	100	50	50	5	95
3	30	130	100	50	50	5	95
4	30	130	100	50	50	5	95
5	100	130	30	50	-20	0	30
6	30	130	100	50	50	5	95
7	30	130	100	50	50	5	95
8	30	130	100	50	50	5	95
S		300	300				300

DDBD Method

n	Before tax cash flow			DDBD = 2/N (BV_t-1)	BV_t	Taxable income	Pajak 10 %	After tax cash flow
	(-)	(+)	NCF					
(a)	(b)	(c)	(d=c-b)	(e)	(ft = dt-1 - BVt)	(g=d-e)	(h=gx10%)	(i=d-h)
0	700		-700		700			-700
1	30	130	100	175	525	-75	-7.5	107.5
2	30	130	100	131	393.75	-31.25	-3.125	103.125
3	30	130	100	98	295.31	1.5625	0.15625	99.84375
4	30	130	100	74	221.48	26.17188	2.6171875	97.38281
5	100	130	30	55	166.11	-25.3711	0	30
6	30	130	100	42	124.58	58.47168	5.84716797	94.15283
7	30	130	100	31	93.44	68.85376	6.88537598	93.11462
8	30	130	100	23	70.08	76.64032	7.66403198	92.33597
S		300	300					300