TSP-308/ 3 SKS

Metoda dan Peralatan Konstruksi

Silabus Singkat

Kuliah ini memperkenalkan berbagai metoda, teknologi dan jenis-jenis peralatan konstruksi, termasuk karateristik teknis, dan prinsip pengoperasian peralatan konstruksi, serta perencanaan sistem pembangunan dan perhitungan produktivitas peralatan sebagai bagian dari proses kegiatan konstruksi

- **Pengenalan berbagai metoda dan teknologi serta berbagai peralatan konstruksi yang umum digunakan pada pelaksanaan pekerjaan rekayasa sipil.**
- **Konsep manajemen peralatan; pemilihan peralatan, optimasi penggunaan alat, dasar perhitungan biaya peralatan.**
- **Pengenalan karakteristik dan pengoperasian peralatan untuk pekerjaan, persiapan, pekerjaan tanah, pekerjaan pondasi dan pekerjaan konstruksi beton.**

topics

1. Gambaran umum proses konstruksi dan peran peralatan konstruksi
2. *Planning And Earth Moving Material*
3. *Truck & Hauling Equipment*
4. *Compaction **and Stabilization Equipment***
5. Peralatan dan mekanisme Scrapper
6. Peralatan dan mekanisme Excavator
7. UTS
8. Peralatan dan mekanisme Grader
9. Peralatan dan mekanisme Crane
10. Metoda Pekerjaan pondasi
11. Peralatan pompa
12. Pekerjaan struktur sementara
13. Pekerjaan beton
14. Pekerjaan konstruksi sipil non-gedung
15. UAS

Aturan Umum

- 3 SKS
- Jumat, 08:00 – 10:30
- Kehadiran (10%)
- Tugas / kuis (25%)
- UTS (30%)
- UAS (35%)

Suggested Reading

- Peurifoy, Schexnayder, and Shapira, **Construction Planning, Equipment and Methods 8th ed**., McGraw Hill, 2011
- S.W. Nunnally, **Construction Methods and Management, 8th ed**., Prentice Hall, 2009


Introduction to
Construction Equipment and Method

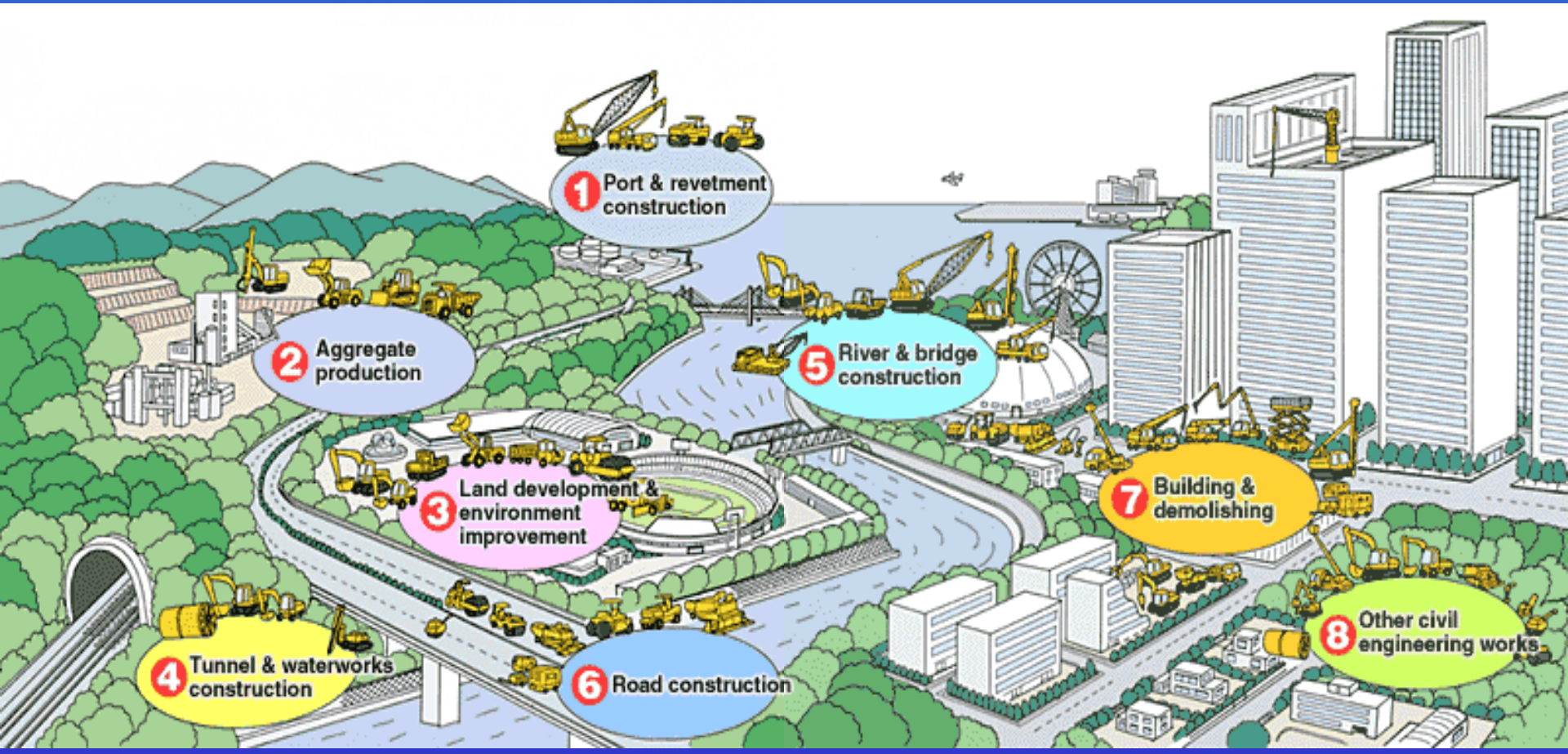
Construction Method

- Description of approaches and techniques to execute certain task
- Description of how things are being built or produced or accomplished
- Interaction of man, machine and material
- Objective:
  - Finding the best (optimal) use of resources
  - Maintain safety of process

Tools and Equipment

- Tools and (heavy) equipments are devices to help human to overcome limitation (force, range, safety, ..) in performing his/her task.
- Tools and equipment must be designed and built within the control of human.
- Basic principles of equipment and machinery are physic and mechanics

Construction Equipment



1. Crawler cranes, truck cranes, hydraulic excavators, wheel loaders, tire rollers, vibratory rollers, tower cranes, floating cranes, etc.

2. Bulldozers, dump trucks, wheel loaders, crawler loaders, crawler drills, asphalt plants, concrete plants, etc.

3. Hydraulic excavators, carriers for use on rough roads, scrapers, bulldozers, wheel loaders, motor graders, tire rollers, vibratory rollers, etc.

4. Tunnel boring machines for use in bedrock, shield machines, micro tunneling machines, anchor drills, hydraulic excavators, etc.

5. Crawler cranes, truck cranes, pile drivers, hydraulic excavators, carriers for use on rough roads, floating cranes, etc.

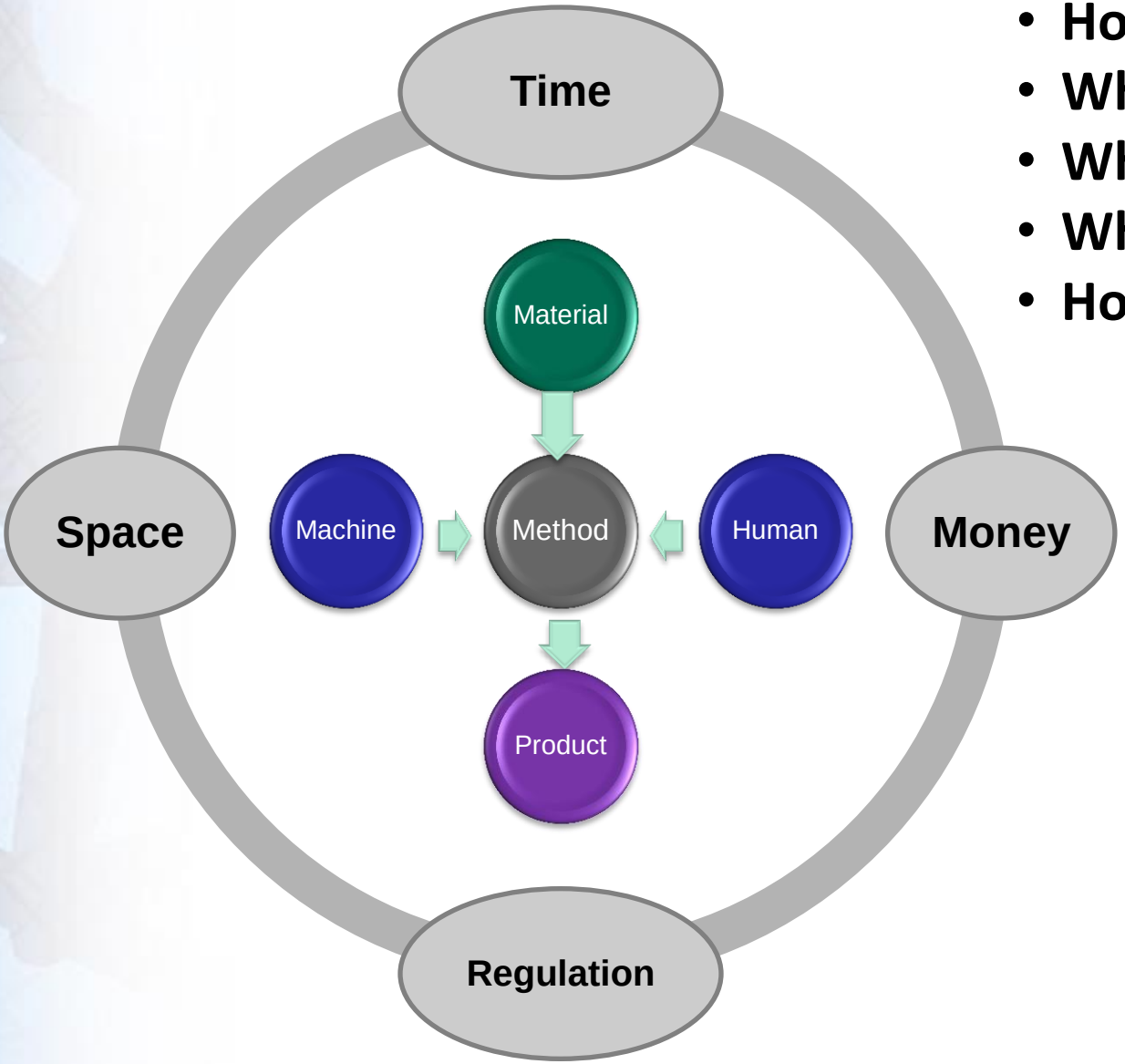
6. Compacting machines, various rollers, asphalt finishers, hydraulic excavators, bulldozers, scrapers, motor graders, carriers for use on rough roads, compressors, anchor drills, etc.

7. Hydraulic crushers, hydraulic breakers, hydraulic excavators, self-driven crushers, various cranes, concrete pump cars, pile drivers, aerial works platforms, compacting machine, etc.

8. Mini-excavators, aerial works platforms, hydraulic excavators, asphalt finishers, compacting machines, various loaders, concrete mixer cars, shielding machines, micro tunneling machines, etc.

Construction Equipment that Delivers Quality to Life

Construction Equipment & Method



- **How** (do we do)
- **Why** (do we use)
- **What** (to use)
- **When**
- **How** many

Steps in Selecting Equipment for Construction

What is need to be done

- Check the contract (plans and specs)

How does it going to be done

- Work process
- Resource needed (material)
- Quantity and quality of resource

Do we need equipment

- Amount of works
- Available time
- Work / task condition (requirement)
- Safety

What kind of (combination) equipment do we need

- Work specs (amount and quality of works)
- Productivity
- Availability
- Economics

ECONOMIC CONSIDERATION of HEAVY EQUIPMENT SELECTION

Objective: to find the lowest hourly charge

TOTAL COST = OWNERSHIP COST + OPERATION COST

BUY (for most of the time)
LEASE (with option to buy)
RENT

- DEPRECIATION
- I.TI.S (Interest, Tax, Insurance, Storage)

EQUIPMENT OPERATOR

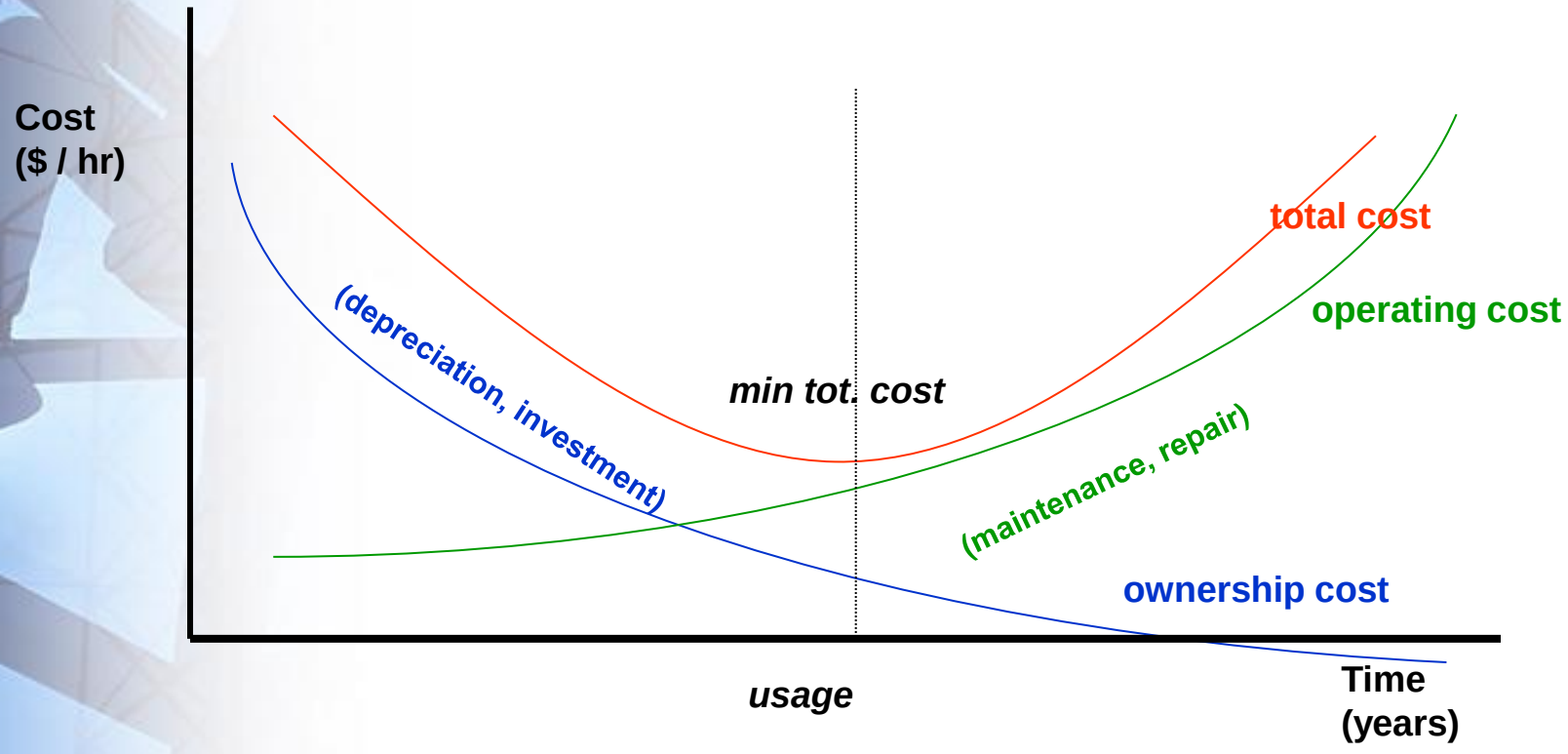
- FUEL
- LUBRICANT, FILTER
- TIRE
- REPAIR
- Operator's WAGES
- OTHER

- **POPULATION & UNIFORMITY OF EQUIPMENT**
- **MOBILIZATION & DEMOBILIZATION**

Equipment Cost Consideration

- Life Time
  - Useful life
  - Tax life
  - Economic life
- Type of Equipment
  - Standard
  - Special purposed
- Time Value of Money

Equipment Cost Consideration



Estimating Equipment Cost

- **Fuel Consumption**

Gasoline engines $Qg = \frac{0.7 \times hp \times (\text{load factor})}{6.2}$, (gph)

Diesel engines $Qd = \frac{0.5 \times hp \times (\text{load factor})}{7.2}$, (gph)

- **Lubricant Consumption**

$$Ql = \frac{0.6 \times hp \times (0.007)}{} + 7.4 \frac{C}{t}, \text{(gph)}$$

hp = horse power
C = crankcase capacity, gal
t = number of hours between changes

- **Ownership Cost**

Depreciation Cost

I.T.I.S. (Interest, Tax, Insurance, Storage) (%)

Average Annual Value $= \frac{(n+1)P + (n-1)S}{2n}$

1 gal = 3.785 liter 1 mile = 1.61 Km

Exercise

DUMPTRUCK:

- Crankcase capacity 9 gal
- Power = 230 HP (diesel fuel engine)
- Free On Board (F.O.B) price = Rp 415.000.000,-
- Transport Cost = Rp 37.000.000,-
- Wheel Cost (8 wheels) = Rp 3.350.000,-/wheel
- Useful life = 7 years
- Salvage Value = Rp 96.650.000,- (cash inflow for a machine at time of disposal)
- Operating hours = 1850 hours/year
- Interest, Tax, Insurance, Storage (IT IS) = 12%
- Fuel cost = Rp 2.100 / gal
- Lubricant cost = Rp 97.800 /gal
- Time for changing = 175 hours
- Filter cost = @ 30% lubricant cost
- Tire replacement cost = Rp 650.000/1675 operating-hour
- Operator cost = Rp 26.500,- /hour
- Method of Depreciation = Straight line

Answer (1)

1. OWNING COST:

- F.O.B. = Rp 415.000.000
- Less Tire (8 @ Rp 3.350K) = Rp (26.800.000)
- Transport Cost = Rp 37.000.000
- Depreciable Cost = Rp 425.200.000

- Depreciation Cost = (Rp 425.2M – Rp 96.65M) / 7 yrs
  = Rp 46.935.715 /year

- AAV = [(7 +1) * Rp 425.2M + (7-1) * Rp 96.65M] / (2 * 7) = Rp 284.392.857

- ITIS cost = 12% * Rp 284.392.857 = Rp 34.127.140

- Annual Owning Cost = Rp 46.935.715 + Rp 34.127.140 = Rp 81.062.855

- Owning Cost = Rp 81.062.855 / 1.850 hr/yr = Rp 43.818,- / hr

Note: *for track/crawler mounted equipment, wheel cost is included in equipment*

Tire Types

- Track
  - Will be used (almost) the whole life of equipment

- Rubber Tire

Answer (2)

2. OPERATING COST:

- Fuel consumption = [0.5 * 230 * 0.90] / 7.2 = 14.375 gal/hr
- Lub. consumption = [0.6 * 230 * 0.007] / 7.4 + 9/175 = 0.18 gal/hr

- Fuel cost = 14,375 gal/hr * Rp 2.100 / gal = Rp 30.188 /hr
- Lubricant cost = 0,18 gal/hr * Rp 97.800 / gal = Rp 17.797 /hr
- Filter Cost = 30% * Rp = Rp 5.399 /hr

- Tire Cost = [8 *Rp 3.350.000]/1675 hr = Rp 16.000 /hr
- Tire Replacement = Rp 650.000 / 1675 hr = Rp 388 /hr

- Operator Cost = Rp 26.500 / hr

- Operating Cost = Rp 96.272 / hr

3. OWNING & OPERATING COST:

- Total cost = Rp 43.818,- / hr + Rp 96.272 /hr = Rp 140.090 / hr

Assignment #1

- Find an article on construction project, its construction method and the use of advanced equipment
- Write a paper and provide:
  - general description about the project
  - Method/technology and major equipment employed
  - analysis and discussion

Paper must be 5 to 6 pages long (A4), be informative and clearly depicts references

Paper should submitted by 11AM, 13/2/2014.

Thank You