Optimal Design of Energy Systems (M2794.003400)

Chapter 2. DESIGNING A WORKABLE SYSTEM

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Chapter 2. Designing a workable system

2.1 Workable and Optimum systems

- There are many possible solutions, but only one answer is the optimum
- **Non-workable system** < **Workable system** < **Optimum system**

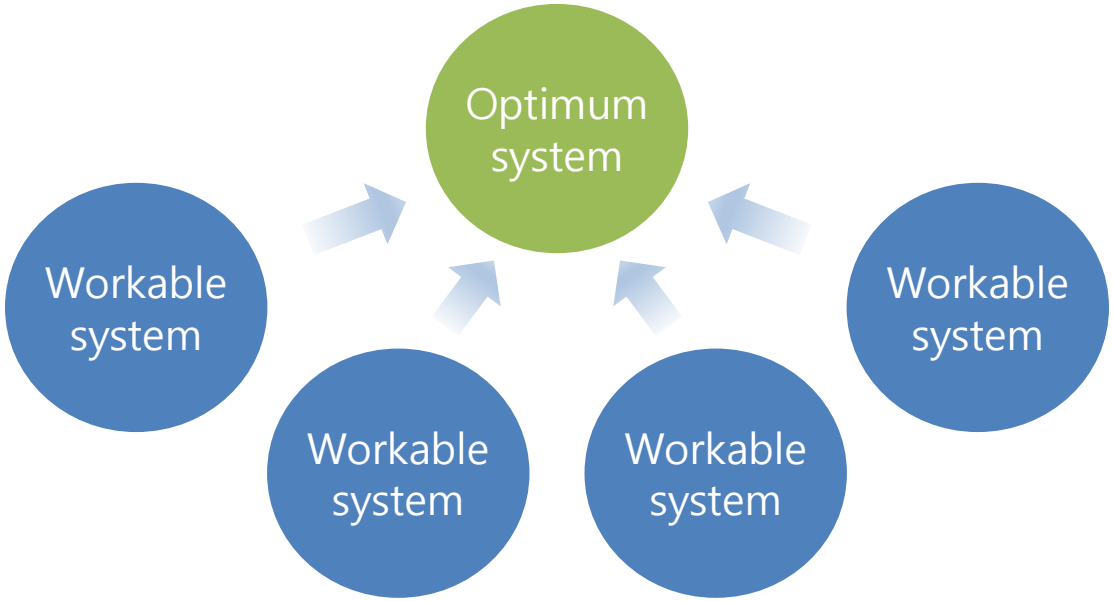

Fig. Relation between workable systems and optimum system

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2.2 A workable system

- Conditions for a workable system

① Meets the requirement of the purpose of the system
(power, heating, cooling, fluid flow, surrounding, etc.)

② Satisfactory life and maintenance costs

③ Abides by all constraints
(size, weight, temperature, pressure, noise, pollution, etc.)

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2.3 Steps in arriving at a workable system

- The two major steps in achieving a workable systems

① Select the concept to be used

② Fix whatever parameters must be chosen

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2.4 Creativity in concept selection

- To get creativity in concept selection

① Review all the alternative concepts in some manner appropriate to the scope of the project

② Old ideas that were once discarded as impractical or uneconomical should be constantly reviewed

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2.5 Workable vs. optimum system

- Example : 3 kg/s of pipe water should be delivered from one location to another 250 m away from the original position and 8 m higher. A water pump and pipe type are need to be selected.

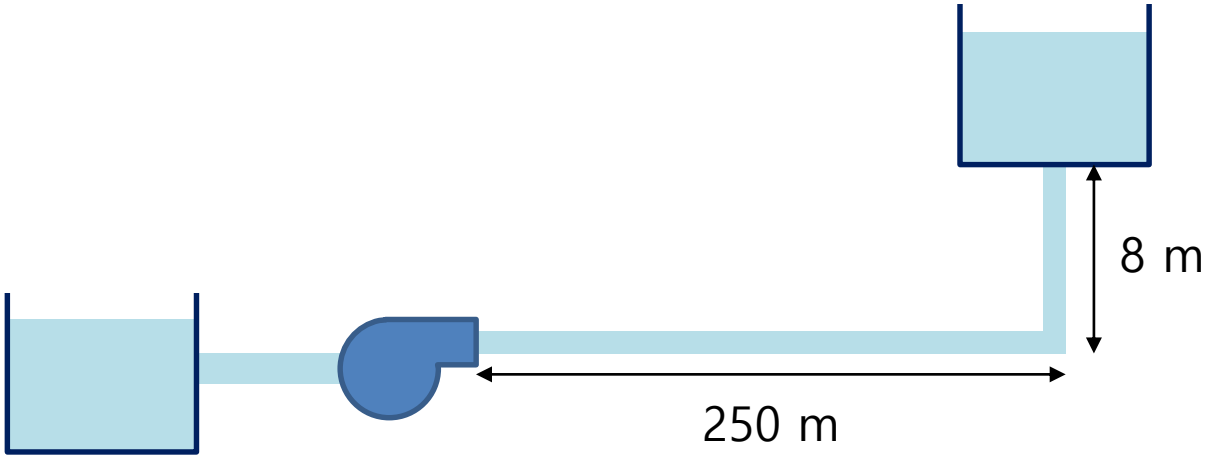

Fig. Pipe water transfer problem

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2.5 Workable vs. optimum system

- Workable solution

① ΔP from the elevation is $(8\ \mathrm{m})(1000\ \mathrm{kg/m^3})(9.81\ \mathrm{m/s}) = 78.5\ \mathrm{kPa}$

② **Arbitraily choose the type of pipe**, which imposes $\Delta P = 100\ \mathrm{kPa}$

③ Choose the pump which delivers 3 kg/s against a pressure difference of 178.5 kPa

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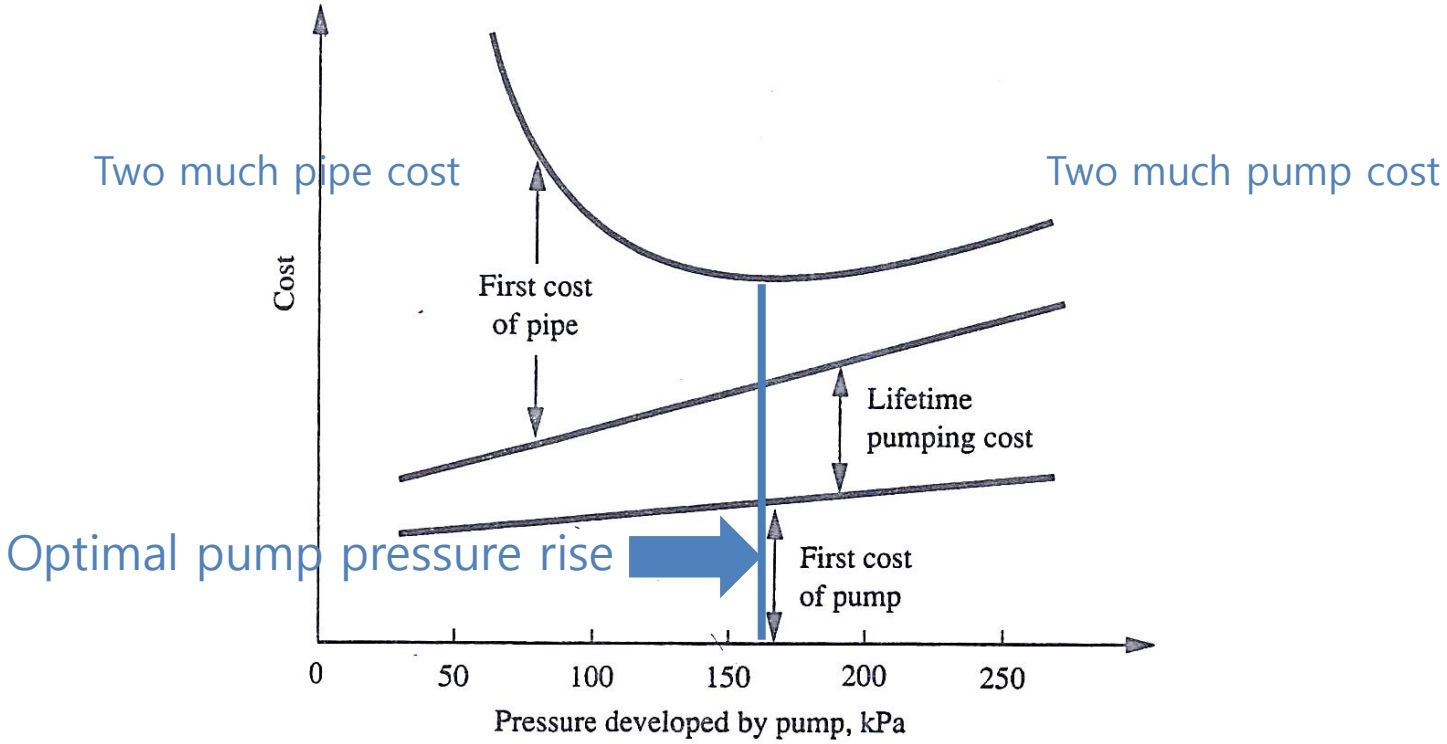
2.5 Workable vs. optimum system

- Optimum solution



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2.5 Hot air balloon

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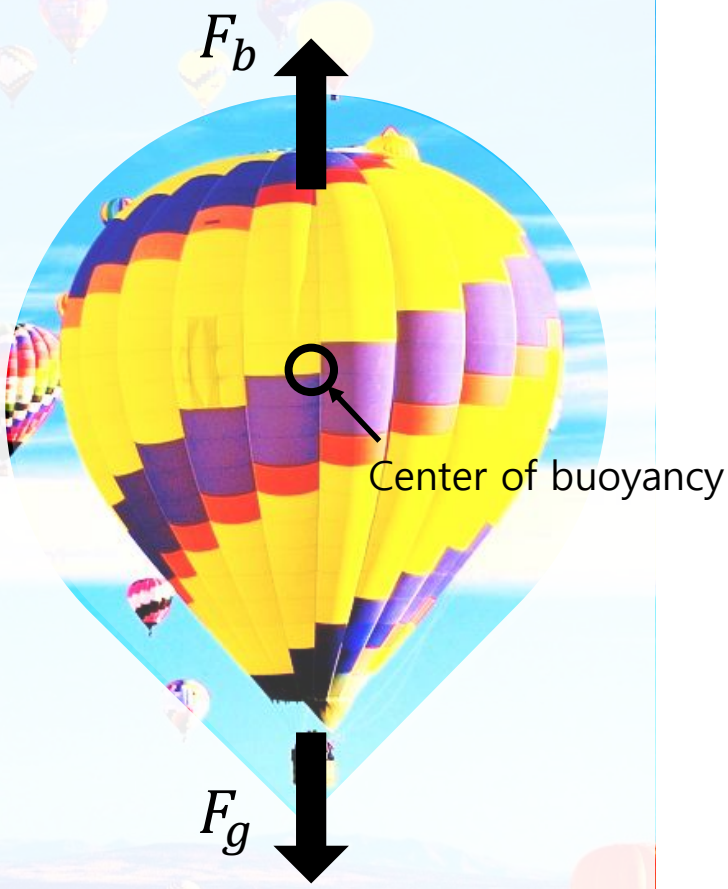
2.5 Hot air balloon

Ideal gas law(He) : $P = \rho_{He} RT$

Buoyancy force : $F_b = \rho_{He} g V_{balloon}$

Gravitational force : $F_g = m_{balloon} \mathrm{g}$



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2.5 Soaring plane

- Motorless glider
- Towed by the towing airplane and gliding 1 km over the ground

Fig. Pipe water transfer problem

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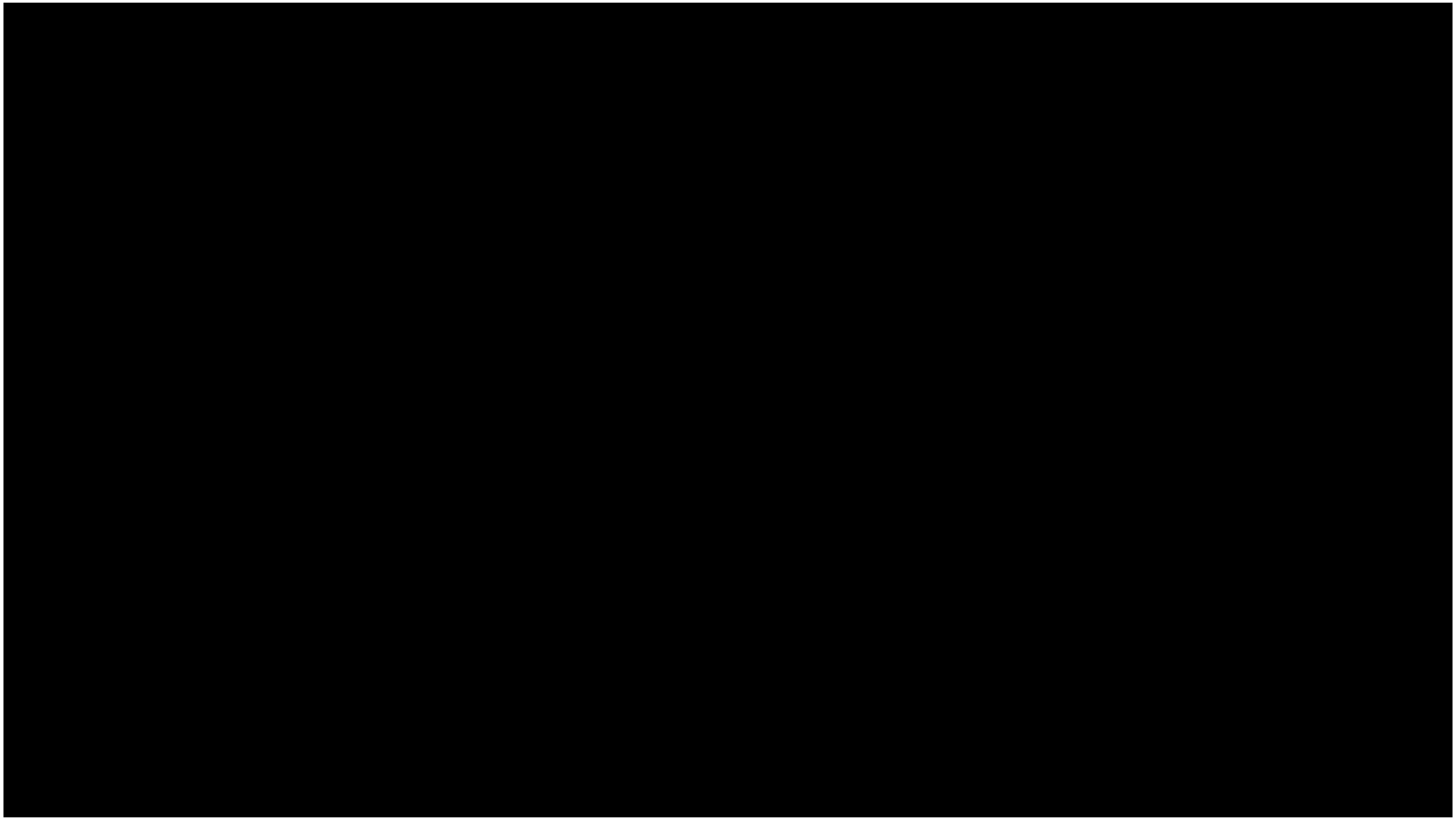
2.5 Soaring plane



https://youtu.be/ndACTiIsYL8

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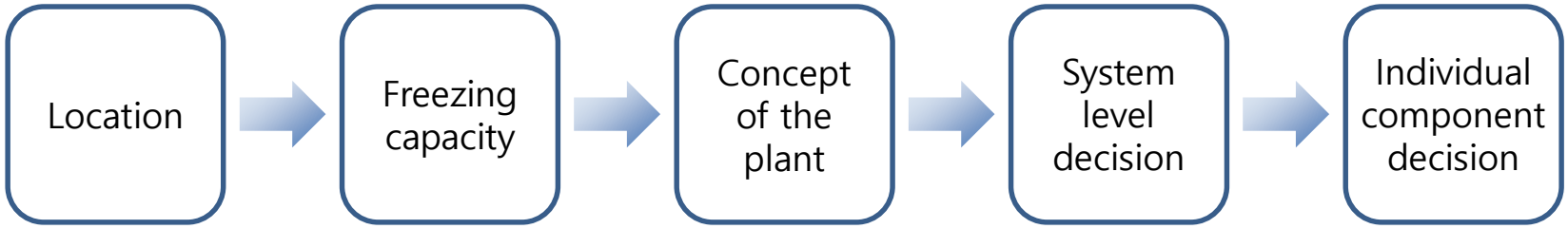
2.6 Design of a food-freezing plant

- A food company can buy sweet corn and peas from farmers during the season and sell the vegetables as frozen food throughout the year in a city 300 km away. What are the decisions and procedures involved in designing the plant to process and freeze the crops?

- Major decisions : (1) Location (2) Size (3) Type of freezing plant
- Decision procedures



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2.6 경기도 친환경 물류유통센터

위치	경기도 광주시 곤지암읍 경충대로 731
대지면적 / 연면적	68,972 m2 / 25,927 m2
건물규모	집배송장, 저온저장고, 소분포장, 안전성검사실,전처리실,교육장, 식당, 사무실 등

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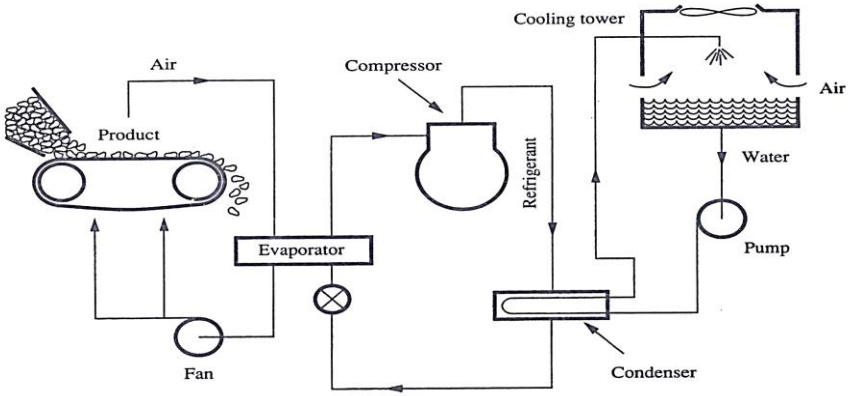
1. Location :

Adjacent to a refrigerated warehouse operated by company

2. Freezing capacity :

On the bias of the current availability of the crop, the potential sale in the city, and available financing.

3. Plant concept :



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4. System level decision : 220 kW

	Temperature, ℃
Air, chilled supply	-30
Air return	-20
Refrigerant, evaporation	-38
Refrigerant, condensation	45
Condenser, cooling water, inlet	30
Condenser, cooling water, outlet	35

5. Component level decision :

Evaporator
220 kW

Compressor
80 kW

Condenser
300 kW