Chapter 2. DESIGNING A WORKABLE SYSTEM

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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**

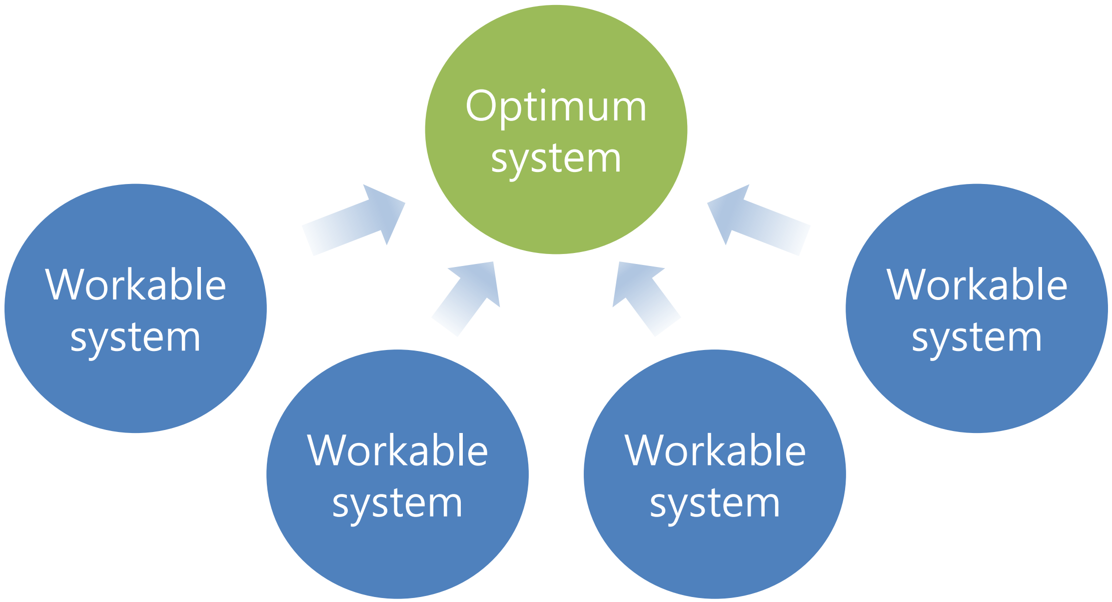

Fig. Relation between workable systems and optimum system

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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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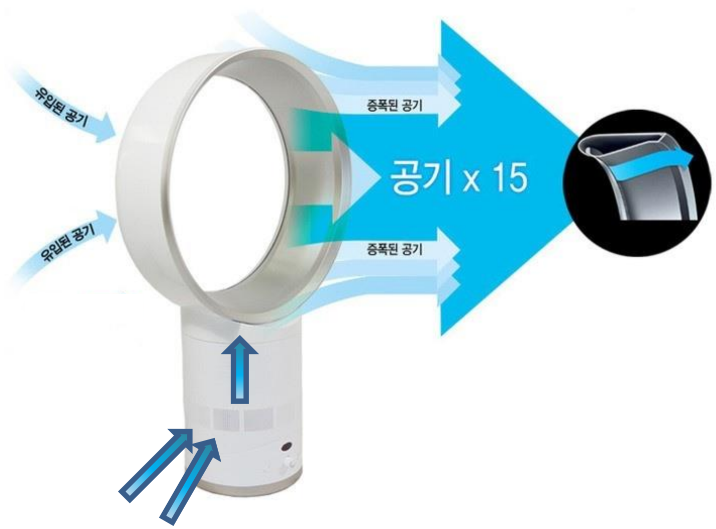
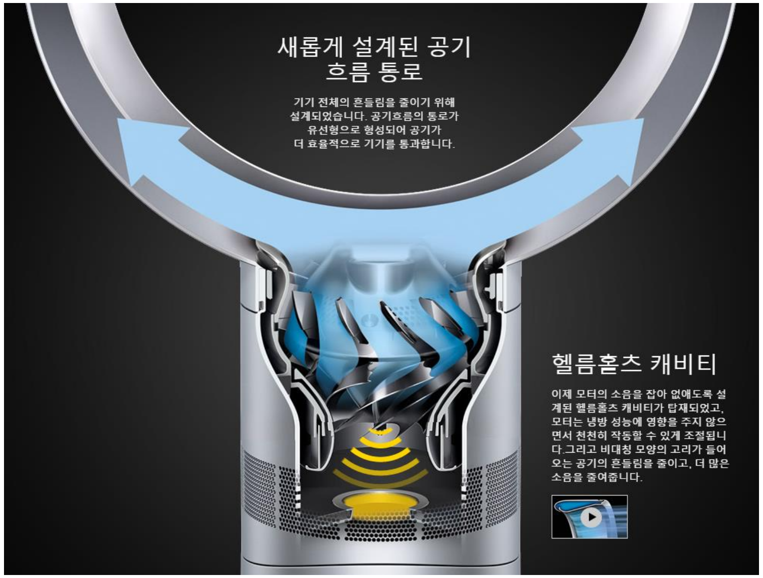
- **Dyson의 날개없는 선풍기(Air Multiplier)**





- ✓ 비행기 날개 모양의 선풍기 단면
- ✓ 주변의 공기를 흡수하여 바람 세기 증폭
- ✓ 최대 75% 조용, 최대 30% 적은 에너지 소모

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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.

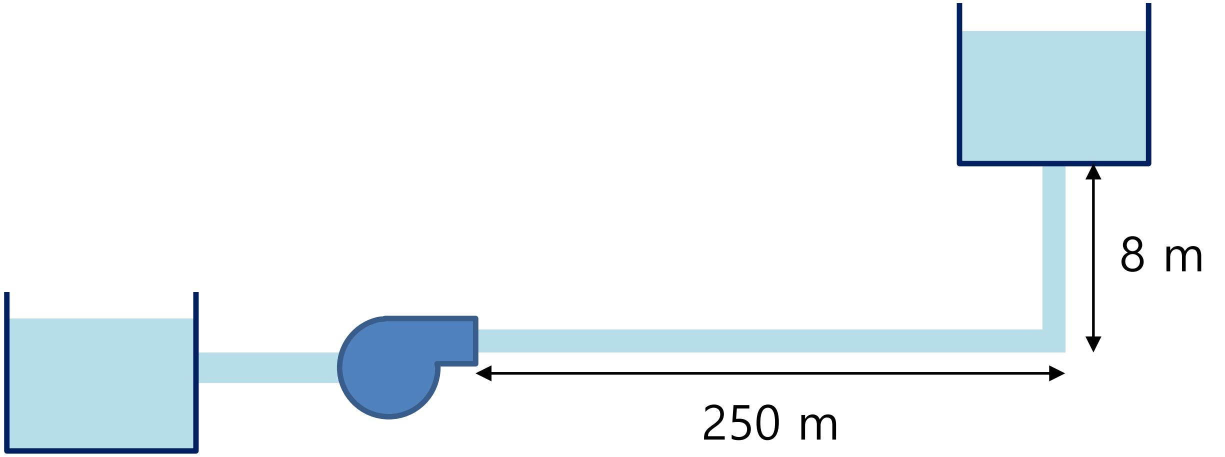

Fig. Pipe water transfer problem

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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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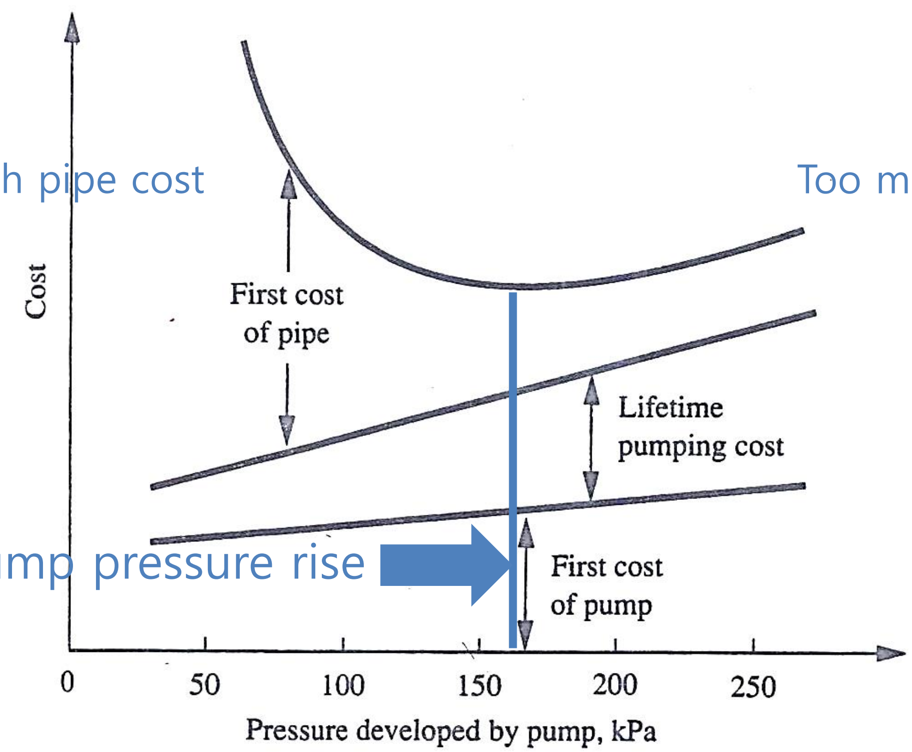
2.5 Workable vs. optimum system

- Optimum solution

Too much pipe cost

Too much pump cost

Optimal pump pressure rise



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2.5 Hot air balloon

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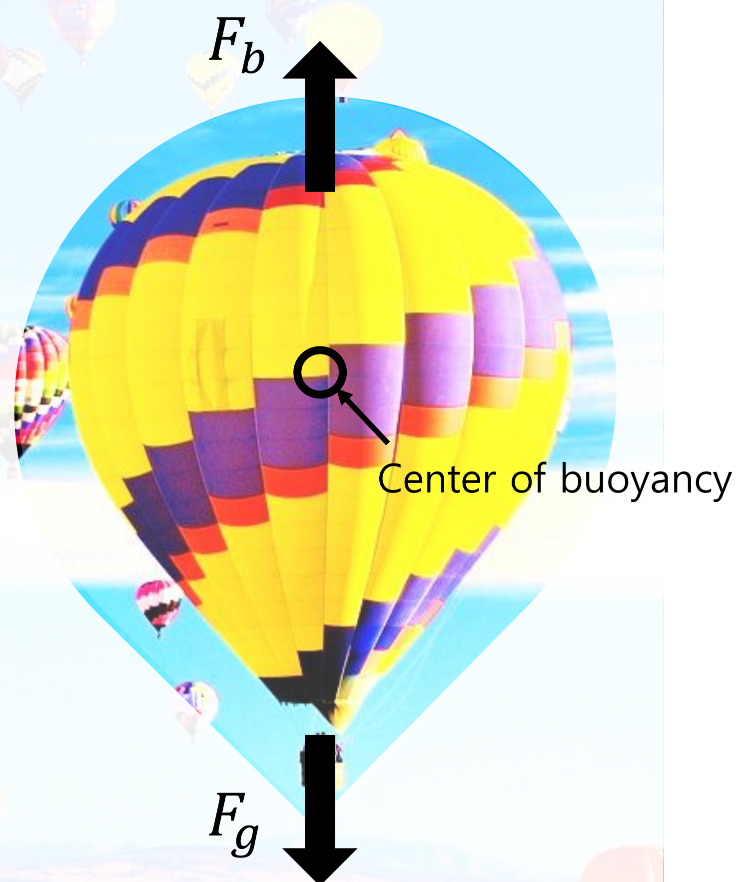
Ideal gas law : $P = \rho RT$

Buoyancy force : $F_b = (\Delta\rho_{air})gV_{balloon}$
$(\Delta\rho_{air} = \rho_{surround} - \rho_{hot\ air})$

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