①

$f_{ROTATION}$?

$T_{SEEK}=6ms$ $T_{TRANSFER}=0,5ms$ $T_{CONTROLLER}\simeq 0$ $T_{I/O}=568ms$ $l=40\%$

$$N=\frac{320KB}{4KB}=80$$

$$\frac{1}{N}T_{I/O}=(1-l)(T_{SEEK}+T_{LATENCY})+T_{TRANSFER}$$

$$=(1-l)(T_{SEEK}+T'_{LATENCY})+T'_{TRANSFER}$$

FROM $^1/_{ms}$ TO RPM

$$=(1-l)(T_{SEEK}+\frac{1}{2}\cdot\frac{60\cdot1000}{f_{ROTATION}})+T'_{TRANSFER}$$

$$\Rightarrow f_{ROTATION}=\left(\left(\frac{\frac{T_{I/O}}{N}-T_{TRANSFER}}{1-l}-T_{SEEK}\right)\cdot\frac{1}{30\cdot1000}\right)^{-1}=6000RPM$$

②

$f_{ROTATION}=12000RPM$ $T_{TRANSFER}=0,5ms$ $T_{SEEK}=6ms$ $T_{CONTROLLER}\simeq 0$

$T_{I/O}=550ms$ l? $N=\frac{480KB}{4KB}=120$

$$\frac{1}{N}T_{I/O}=(1-l)(T_{SEEK}+\frac{1}{2}\cdot\frac{60\cdot1000}{f_{ROTATION}})+T_{TRANSFER}$$

$$\Rightarrow l=1-\frac{\frac{1}{120}T_{I/O}-T_{TRANSFER}}{T_{SEEK}+\frac{1}{2}\cdot\frac{60\cdot1000}{f_{ROTATION}}}=52\%$$

③

$TR=10MB/s$ $f_{ROTATION}=7500RPM$ $T_{SEEK}=6ms$ $T_{CONTROLLER}\simeq 0$ $T_{I/O}=320ms$ l?

$M=4KB$

$$T_{I/O}=(1-l)(T_{SEEK}+T_{LATENCY})+T_{TRANSFER}=(1-l)(T_{SEEK}+\frac{1}{2}\cdot\frac{60\cdot1000}{f_{ROTATION}})+$$

$$+\left(\frac{M\cdot1000}{TR\cdot2^{20}}\right)\rightarrow l=1-\frac{T_{IO}-\left(\frac{M\cdot1000}{TR\cdot2^{20}}\right)}{T_{SEEK}+\frac{1}{2}\cdot\frac{60\cdot1000}{f_{ROTATION}}}=82\%$$

④ $TR = 10MB/s$ $F_{ROTATION} = 6000RPM$ $T_{SEEK} = 2ms$ $T_{CONTROLLER} \simeq 0$

$M = 4KB$ $T_{I/O}$?

$$T_{I/O} = T_{TRANSFER} + T_{SEEK} + T_{LATENCY} = \frac{M \cdot 1000}{TR \cdot 2^{20}} + T_{SEEK} + \frac{1}{2} \cdot \frac{60 \cdot 1000}{F_{ROTATION}} = 7{,}39ms$$

⑤ $F_{ROTATION} = 10000RPM$ $T_{TRANSFER} = 0{,}5ms$ $T_{CONTROLLER} \simeq 0$ $l = 60\%$ $T_{I/O} = 800ms$

$N = \frac{800KB}{4KB} = 200$ T_{SEEK}?

$$\frac{1}{N} T_{I/O} = (1-l)(T_{SEEK} + T_{LATENCY}) + T_{TRANSFER}$$

$$T_{SEEK} = \frac{T_{I/O}/N - T_{TRANSFER}}{1-l} - \frac{1}{2} \cdot \frac{60 \cdot 1000}{F_{ROTATION}} = 6{,}75ms$$

⑥ $T_{TRANSFER} = 0{,}4ms$ $F_{ROTATION} = 12000RPM$ $T_{SEEK} = 6ms$ $T_{CONTROLLER} \simeq 0$

$N = \frac{10KB}{2KB} = 5$ $T_{I/O} = 8ms$ l?

$$\frac{1}{N} T_{I/O} = (1-l)\left(T_{SEEK} + \frac{1}{2} \cdot \frac{60 \cdot 1000}{F_{ROTATION}}\right) + T_{TRANSFER}$$

$$\Rightarrow l = 1 - \frac{T_{I/O}/N - T_{TRANSFER}}{T_{SEEK} + \frac{1}{2} \cdot \frac{60 \cdot 1000}{F_{ROTATION}}} = 85{,}88\%$$

⑦ $M = 4KB$ $T_{SEEK} = 3ms$ $T_{TRANSFER} = 0{,}5ms$ $T_{CONTROLLER} \simeq 0$ $l = 75\%$

$T_{I/O} = 400ms$ $N = \frac{800KB}{M} = 200$ $F_{ROTATION}$?

$$\frac{1}{N} T_{I/O} = (1-l)(T_{SEEK} + T_{LATENCY}) + T_{TRANSFER}$$

$$= (1-l)(T_{SEEK} + T_{LATENCY}) + T'_{TRANSFER}$$

$$= (1-l)\left(T_{SEEK} + \frac{1}{2} \cdot \frac{60 \cdot 1000}{F_{ROTATION}}\right) + T'_{TRANSFER}$$

$$\Rightarrow \quad f_{ROTATION} = \left(\left(\frac{\frac{T_{I/O}}{N} - T_{TRANSFER}}{1-l} - T_{SEEK} \right) \cdot \frac{1}{30 \cdot 1000} \right)^{-1} = 10000\,RPM$$