5. Discontinuity spacing

▶ Introduction

-Definition: Distance between two joint intersections in a scanline

-Spacing and frequency: The frequency is the inverse of mean spacing. The inverse of a single spacing is called repetition (or repetition value).

- Spacing
  - Total spacing: Distance between two adjacent joint intersections regardless of joint sets ( )
  - Set spacing: Distance between two adjacent joint intersections belonging to the same joint set ( )
  - Normal set spacing: Set spacing measured along the joint normal ( )

- Expression: cf.

(: acute angle between a scanline and joint normal)

(total linear frequency is an inverse of the mean total spacing)

((set) linear frequency is an inverse of the mean set spacing)

(normal linear frequency is an inverse of the mean normal set spacing)

▶ Discontinuity spacing distributions

- Poisson distribution of joint intersections: Combined joint intersections of all joint sets are randomly located along scanlines on the whole. (refer to Fig. 5.4, p.127)

- Spacing follows negative exponential: (total) Spacing turned out by theoretical and observational approach to follow a negative exponential distribution when the joint intersections are randomly located.

Theoretical approach: When the number of joint intersections obeys Poisson distribution the probability that k of the intersections are located in a scanline whose length is x is as follow (is a linear frequency).

Then, , the probability density function of indicating a probability that total spacing becomes is as follow.

$$— \quad — \quad \leq \quad — \quad —$$

: Negative exponential distribution (mean= ∞ —)

▶ Rock Quality Designation

- Definition: Percentage of the summed length of core pieces which are longer than 10㎝.
- RQD and spacing/frequency: total spacing and total frequency are closely related with RQD.
- TRQD (Theoretical RQD)

Let the random variable of total spacing be and PDF of be . When the length of rock core is ,

① Total frequency:

No. of joint intersections:

No. of joint pairs whose spacing is :

② No. of joint pairs whose spacing :

Sum of spacing :

③ Let threshold of RQD be . Then $TRQD_t$ becomes:

④ When the spacing obeys negative exponential distribution:

(이 충분히 클때)

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- TRQDt vs. Mean spacing: refer to Fig. 5.5 (p.130).

- TRQDt vs. Frequency: refer to Fig. 5.6 (p.131).

▶ Accuracy and precision of discontinuity spacing estimates

- Error in spacing measurement:
  - Inaccuracy: Consistent error caused by persistent factor. ex) Spacing greater than L cannot be measured by a scanline of which length is L.
  - Imprecision: Inconsistent error caused by sampling size. As the sampling size increases the variance of mean spacing becomes smaller.

① Inaccuracy caused by short sampling lines

- Curtailment: Ignoring some samples whose values are greater than a certain level. It is classified into two groups according to whether the samples are counted/recorded or not: truncated (not counted) and censored (counted). Spacing greater than L is always truncated by a scanline of which length is L.

- Mathematical expression of curtailment

$\rightarrow$:

When

Eqn.(5.13) p.135

(As $\rightarrow \infty$ becomes —)

(As $\rightarrow \infty$ becomes —)

Eqn.(5.14) p.135

Eqn.(5.15) p.135
Fig. 5.7 p.136, Fig.5.8, Fig. 5.9

② Imprecision caused by small sample sizes

- Table 5.1 (p.141), Fig. 5.10 (p.142)
- As the scanline length increases the sample size of spacing also increases addressing the imprecision problem
- Application of the central limit theorem to mean spacing enables us to estimate the confidence range of the mean spacing by using the standard normal distribution.