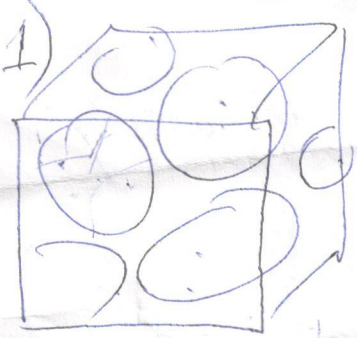
1)



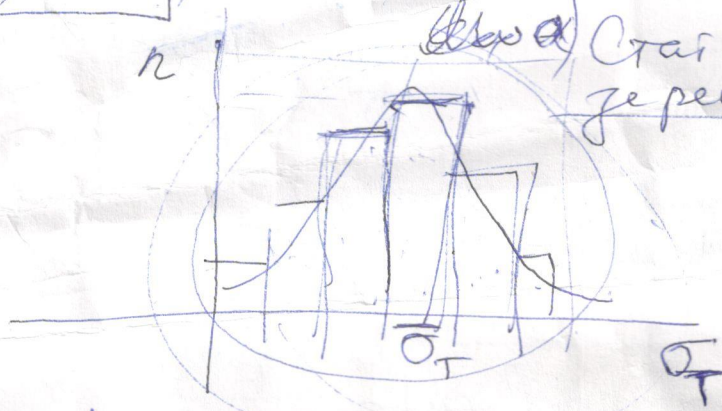
Статическ. прочность Бородин

Статистическая модель прочности

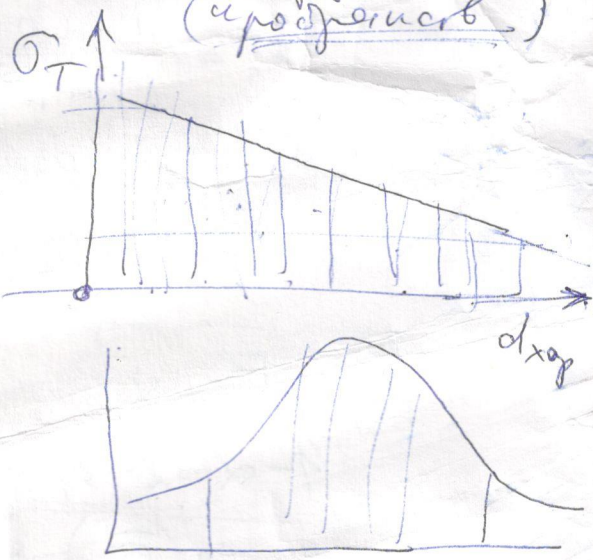
3-х поверхностей критерий прочности

σ_T, σ_C, σ_S. $\sigma_T = \sqrt{3}\,\sigma_S$

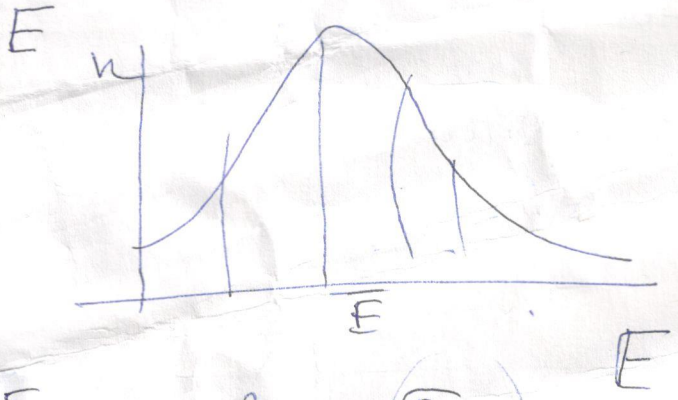
а) Стат. модель распр. прочности зерен



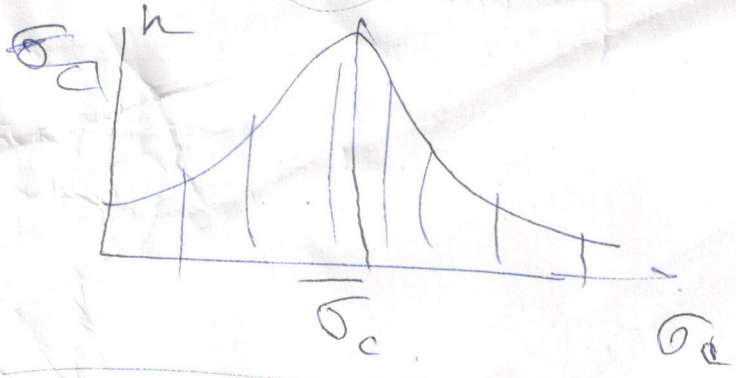
б) Распределение прочности по рамке и ве. (пространств.)

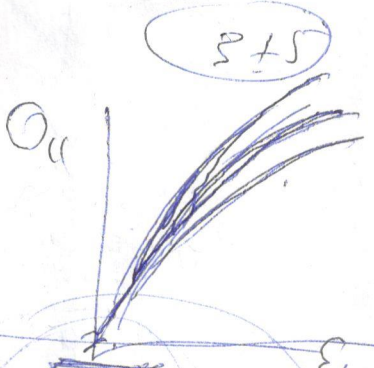


$V = const$ – для всех зер

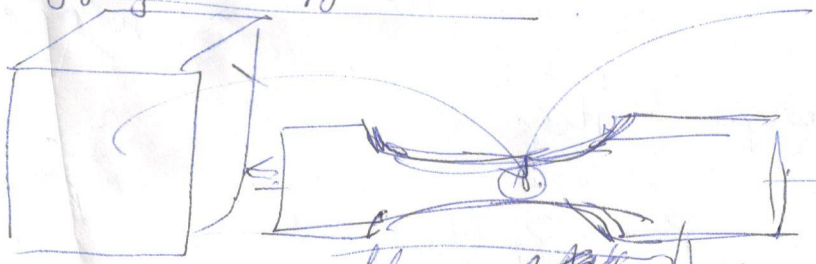


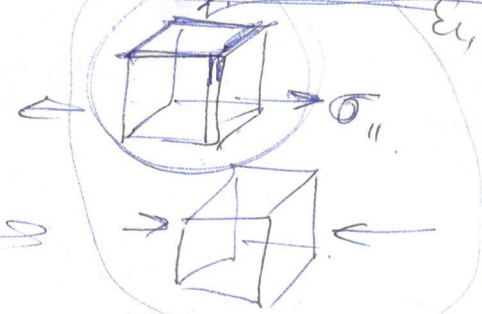
$\begin{cases} E \text{ согласова с } \sigma_T. \\ \sigma_C \text{ согласова с } \sigma_T. \end{cases}$





Решение здесь нарушения





Модуль в АМ Манірова

Расчет пр. (диаграммы)

2) Циклическое нагружение.

Химический критерий длительной прочности.

$$Z(t) = Z_0 + Z_r$$

$$Z_0 = \frac{\sigma_u^{0\,2}}{3\sigma_s(1+B\Gamma(\sigma_j))}$$

σ_u — интонавыш. (2 шв

$\sigma_1 = \sigma_{ii}$ (1 шв

$$Z_r = \left(\frac{K_0}{1-\alpha} f_1(k)\, t^{1-\alpha} - \frac{\Gamma_0^2}{(1-\beta)^2} f_2(k)\, t^{2-2\beta}\right)\sigma_u^2$$

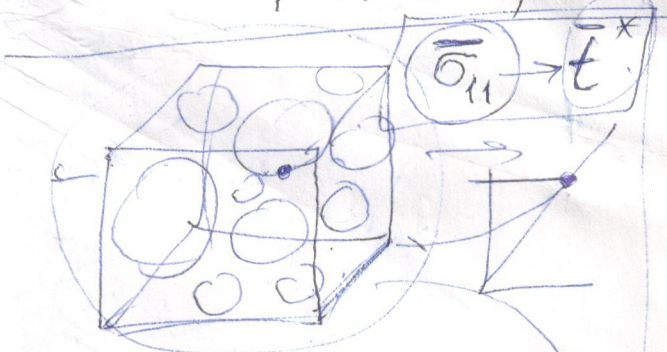
$$f_1(k) = \frac{k^2+0.5}{(1+|k|)^2}, \quad f_2(k) = \frac{k^2}{(1+|k|)^2}$$

k — коэфф. асимметрии. $-\infty < k < +\infty$

$$\sigma_{ij} = \frac{\sigma_{ij}^0}{1+|k|}(kt\sin\omega t)$$

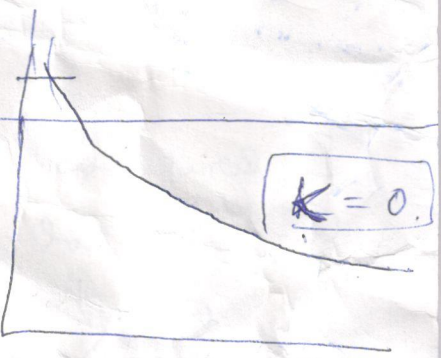
$\boxed{K_0, \Gamma_0, \alpha}$

$1-\alpha = 2-2\beta$



$\boxed{Z(t_*) = 1}$

подчин. кривую установ. и, сравним с экспер., найдём конст. $\boxed{K_0, \Gamma_0, \alpha}$

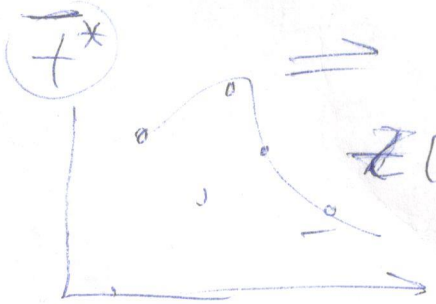


Поле микронапр. в ЯП бд разрушения

σ_{ij} (σ_u, σ_1)

$\sigma_1 = \sigma_{ii}$

Найти точку $\vec{\xi}$ $\max\limits_{\xi} \sigma_u$, $\sigma_{н,max}$, σ_1

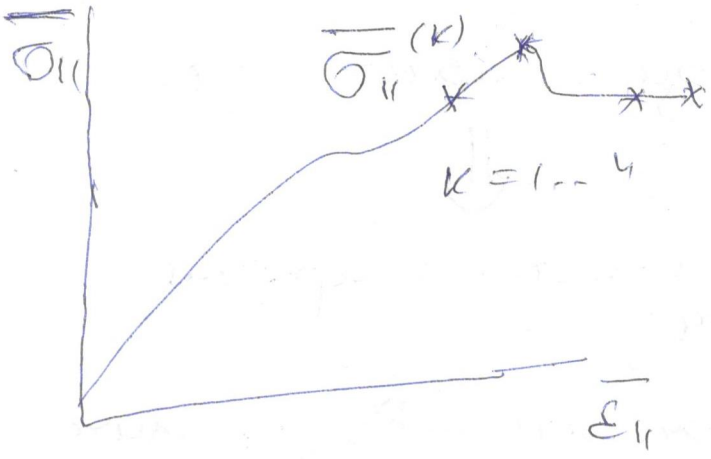


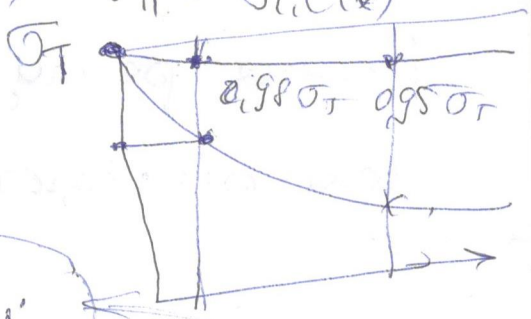
$\Rightarrow$ найдём $\boxed{\max\limits_{\xi} Z}$ $(t_*) = 1$.

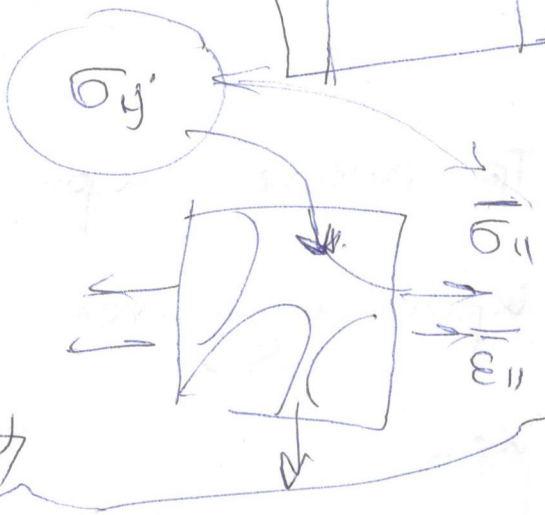
$$Z(t_*) = \boxed{Z_0 + Z_r(t_*) = 1} \Rightarrow$$ Неодн. бр. t^* до установления

$$\sigma_u = \frac{1}{\sqrt{2}}\sqrt{(\sigma_{11}-\sigma_{22})^2+(\sigma_{11}-\sigma_{33})^2+(\sigma_{22}-\sigma_{33})^2+6(\sigma_{12}^2+\sigma_{13}^2+\sigma_{23}^2)}$$

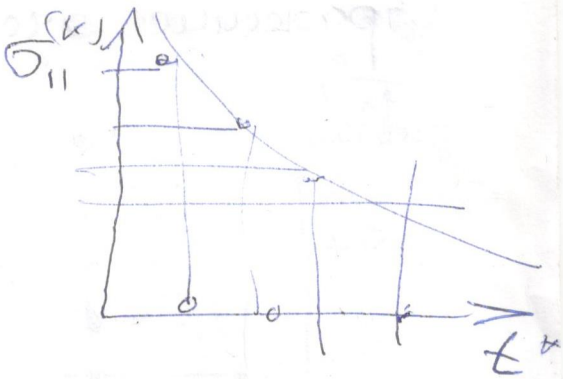
$\sigma_u = |\sigma_{11}|$ $\quad \gamma(t_*)=1 \Rightarrow \sigma_{11}=\sigma_{11}(t_*)$





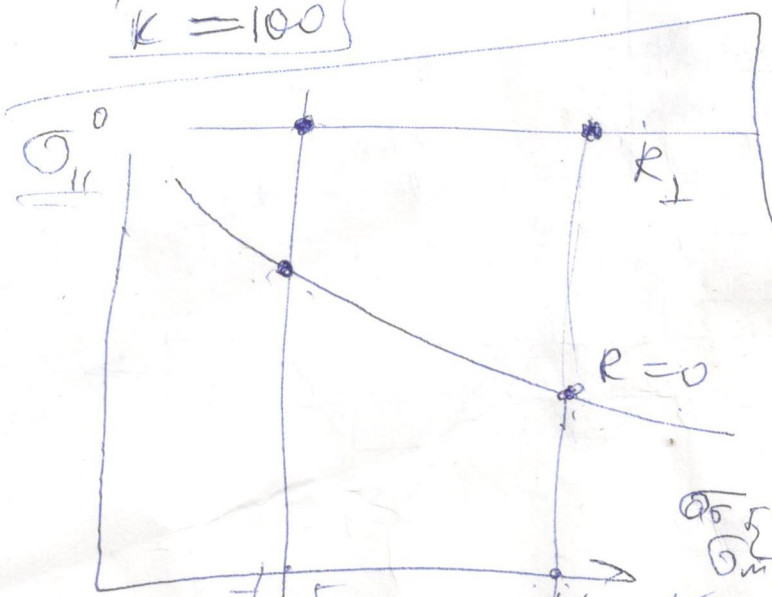


$\overline{\sigma_{11}}^{(k)} \rightarrow \sigma_y^{(k)} \rightarrow \sigma_u^{(k)} \rightarrow t_*^{(k)}$



Разные точки:

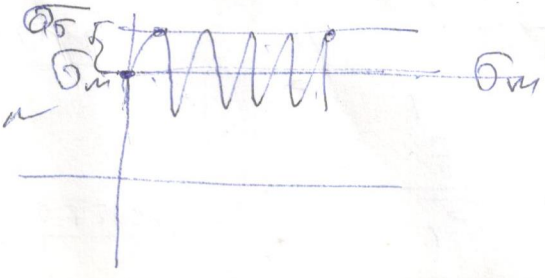
$k=100$



$\Gamma_0,\ K_0,\ \alpha,\ \beta.$

$\sigma_{11}^0 = \sigma_m + \sigma_a$

$\sigma_{am} = (1+|K|)\,\sigma_a$



Межзеренная – ниже прочность / 2 раза меньше.

Модуль упругости – меняем, меньше зависимо

Коэф. Пуассона – постоянный

Прочность – $\sigma_т$

Разные реализации:

Чем отличаются? Разные константы.

⇓

Усталостная кривая.

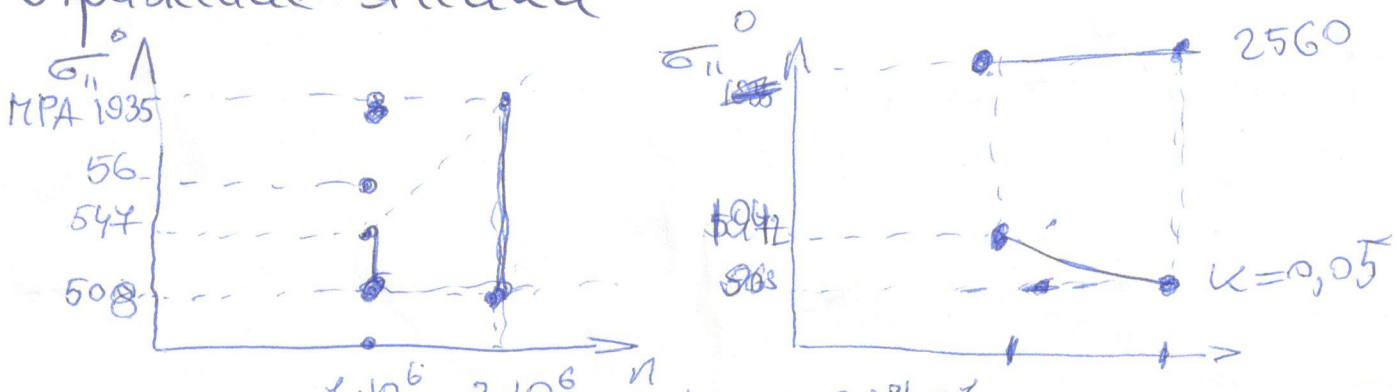
Три точки – 1 реализация

Кривая длительной прочности – без циклической.

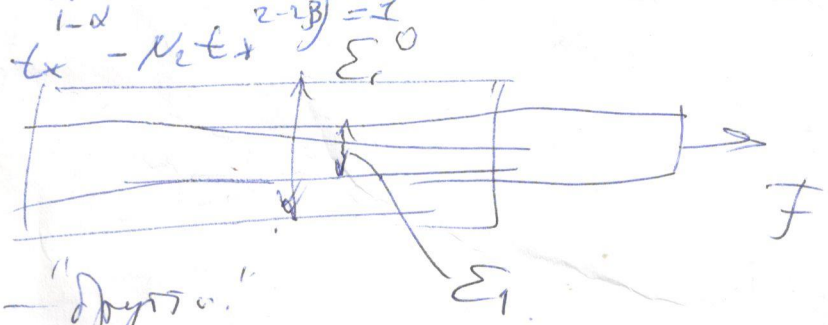
Как $\sigma_a^2\left[(B+N_1)\,t_{*1}^{1-\alpha} + (B-N_2)\,t_{*2}^{2-2\beta}\right] = 1$

$$t_1 = \frac{1 - \sigma_a^2 (B-N_2)\, t_2^{2-2\beta}}{\sigma_a^2 (B+N_1)}$$

Отражение ячейки



$$B(\sigma_a^0)^2 + (\sigma_a^0)^2 (N_1 t_1^{1-\alpha} - N_2 t_2^{2-2\beta}) = 1$$



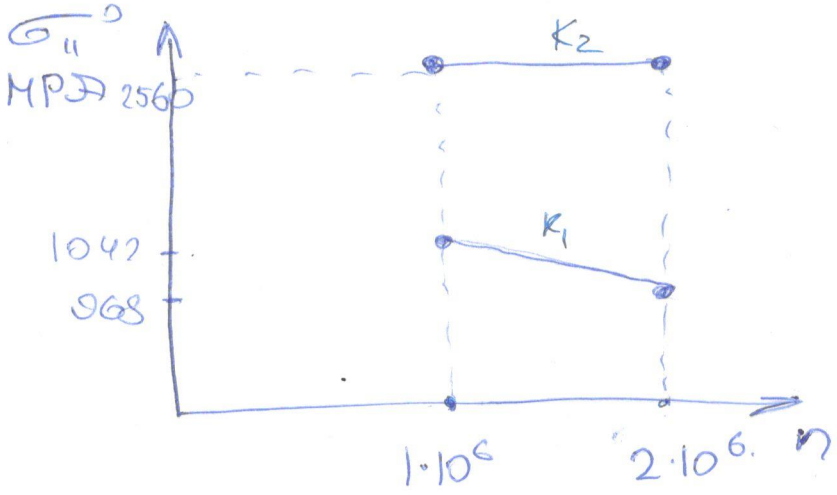
$P_{II} = \frac{\mathcal{F}}{\Sigma_1^0}$ – "брутто"

$T_{II} = \frac{\mathcal{F}}{\Sigma_1}$ – "нетто"

$$\sigma_u^2 = \frac{1}{[(B+N_1)t_*^{1-\alpha} + (B-N_2)t_*^{2-2\beta}]}$$

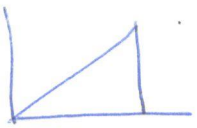
$$N_1 = \frac{k_0}{1-\alpha}\,\frac{k+0{,}5}{(|k|+1)^2} \qquad 1-\alpha = 2-2\beta$$

$$N_2 = \frac{\Gamma_0^2}{(1-\beta)^2}\,\frac{k^2}{(1+|k|)^2}$$



E = 200

E = 10:



$\sigma_T = 0{,}8$

$\sigma_c = 0{,}8$

$\sigma_T = 0{,}7$

$\sigma_c = 0{,}7$

$\sigma_T = 0{,}6$

$\sigma_c = 0{,}6$

1) Как от n перейти к t_*?

2) $$t = \frac{N}{\nu} = \frac{N}{\omega}$$

$$[\nu] = \Gamma_y = \frac{\sigma}{c}; \quad [\omega] = \frac{1}{c}$$

$\nu = 10\,\Gamma_y$

σ_S

$\sigma_u = \sigma_{11}^0 \equiv \sigma^0$

$\sigma_{SI} \equiv \sigma^0(t_{*S}, k_I)$ $\qquad S = 1,2\ ,\ I = 1,2$

$$\sigma_{SI}^2 \left(B + N_{1I} t_S^{1-\alpha} - N_{2I} t_S^{2-2\beta}\right) = 1$$

найти

$$B + \frac{k_0}{1-\alpha} f_{1I}\, t_S^{1-\alpha} - \frac{\Gamma_0^2}{(1-\beta)^2} f_{2I}\, t_S^{2-2\beta} = \frac{1}{\sigma_{SI}^2}$$

$$M_{1S} \equiv \frac{k_0}{1-\alpha} t_S^{1-\alpha}, \qquad M_{2S} \equiv \frac{\Gamma_0^2}{(1-\beta)^2} t_S^{2-2\beta}$$

$$B + M_{1S} f_{1I} - M_{2S} f_{2I} = \frac{1}{\sigma_{SI}^2}$$

$S=1$

$$B + f_{1I} M_{11} - f_{2I} M_{21} = \frac{1}{\sigma_{1I}^2}, \quad I = 1, 2$$

т.е.

$$\begin{cases} f_{11} M_{11} - f_{21} M_{21} = \frac{1}{\sigma_{11}^2} - B \equiv S_{11} \\ f_{12} M_{11} - f_{22} M_{21} = \frac{1}{\sigma_{12}^2} - B \equiv S_{12} \end{cases}$$

$$M_{11} = \begin{vmatrix} S_{11} & -f_{21} \\ S_{12} & -f_{22} \end{vmatrix} \frac{1}{\Delta}$$

$$\Delta = -f_{11} f_{22} + f_{21} f_{12}$$

$$M_{21} = \begin{vmatrix} f_{11} & S_{11} \\ f_{12} & S_{12} \end{vmatrix} \frac{1}{\Delta}.$$

Аналогично

$S=2$ $\quad M_{12}$ и M_{22}

Расход

$$\frac{K_0}{1-\alpha} t_S^{1-\alpha} = M_{1S} \Rightarrow \begin{cases} \frac{K_0}{1-\alpha} t_1^{1-\alpha} = M_{11} \\ \frac{K_0}{1-\alpha} t_2^{1-\alpha} = M_{12} \end{cases}$$

$$\left(\frac{t_1}{t_2}\right)^{1-\alpha} = \frac{M_{11}}{M_{12}} \Rightarrow 1-\alpha = \frac{\ln \frac{M_{11}}{M_{12}}}{\ln \frac{t_1}{t_2}}$$

$$K_0 = (1-\alpha) \frac{M_{11}}{t_1^{1-\alpha}}$$

Аналогично B и Γ_0.

$B =$

$$\begin{cases} z = B \sigma_u^2 = 1 \\ B \equiv \frac{1}{\sigma_T^2} \end{cases}$$

$B \sigma_u^2 +$