

Министерство сельского хозяйства Российской Федерации
Департамент научно-технической политики и образования
ФГБОУ ВО КОСТРОМСКАЯ ГОСУДАРСТВЕННАЯ
СЕЛЬСКОХОЗЯЙСТВЕННАЯ АКАДЕМИЯ

Архитектурно-строительный факультет

очная форма обучения

Кафедра «Технология, организация и экономика строительства»

Расчетно-графическая работа №1

По дисциплине

«Инженерная геодезия»

«Нивелирование поверхности»



РГР принята к проверке кафедре:

№ «_» _____ 201_г.

РГР проверена и передана студенту

для исправления:

«_» _____ 201_г.

Количество ошибок _____

Дата и оценка защиты РГР:

«_» _____ 201_г.

Выполнил(а) студент(ка)

312 группы 1 курса

направление ПГС

архитектурно-строительного

факультета:

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Андреевна

№ зачётной книжки _____

190249

Кострома 2019-2020 гг.

Цель работы: построение топографического плана с помощью
оцилки репера.

Ход работы

1. Принимаем оцилку репера по варианту (49,034)
2. Считаем оцилки станции
3. Прокладываем всевозможные оцилки каждой вершины квадрата
4. Определяем положение функций с шагом 0,25 при помощи ручной интерполяции
5. Выполняем построение плана
6. Вывод.

Расчёт отметок станций

	А	Б	В	Г	Д	Е	
1	0,908	1,085	1,477	0,847	0,465	1,215	1,147
2	0,777	1,224	1,700	1,176	0,945	0,620	
3	2,019	2,236	2,340	1,000	0,620	1,477	1,846
4	2,746	2,491	2,568	1,688	1,510	1,769	
	0,936		0,756	0,252		0,331	
5	2,118	1,572	0,887	0,510	0,340	0,200	
6	0,758	0,991	0,343	0,300	0,725	0,310	

Вычисление и проверка разностей отметки прибора

$$\Delta h_1 = 0465 - 0847 = -382 \text{ мм}$$

$$\Delta h_2 = 0620 - 1000 = -380 \text{ мм}$$

$$\Delta h_3 = 0331 - 1769 = -1438 \text{ мм}$$

$$\Delta h_4 = 0252 - 1688 = -1436 \text{ мм}$$

$$\Delta h_5 = 2568 - 0756 = 1812 \text{ мм}$$

$$\Delta h_6 = 2746 - 0936 = 1810 \text{ мм}$$

} -381
 } -1437
 } 1811

Распределение невязки

Номер станция	Разность Δh (мм)	
	Высшение	Упущение
I	-381	+2 -379
II	-1437	+2 -1435
III	+1811	+3 +1814
Σ	-381-1437+ +1811	-379-1435+ +1814
	-7	0

$$H^I_{\text{П}} = 49,034 + 2,446 = 51,78$$

$$H^{\text{II}}_{\text{П}} = 51,78 - 0,379 = 51,401$$

$$H^{\text{III}}_{\text{П}} = 51,401 - 1,435 = 49,966$$

Абсолютные высоты в каждой вершине квадрата

I

$H_{1-A} = 51,78 - 0,808 = 50,972$	$H_{1-B} = 51,78 - 1,085 = 50,695$	$H_{1-C} = 51,78 - 1,477 = 50,303$
$H_{2-A} = 51,78 - 0,777 = 51,003$	$H_{2-B} = 51,78 - 1,224 = 50,556$	$H_{2-C} = 51,78 - 1,700 = 50,08$
$H_{3-A} = 51,78 - 2,019 = 49,761$	$H_{3-B} = 51,78 - 2,236 = 49,544$	$H_{3-C} = 51,78 - 2,340 = 49,44$
(I) $51,78 - 0,847 = 50,933$	(II) $51,401 - 0,465 = 50,936$	$H_{1-D} = (50,933 + 50,936) : 2 = 50,9345$
(I) $51,78 - 1,000 = 50,78$	(II) $51,401 - 0,620 = 50,781$	$H_{3-D} = (50,78 + 50,781) : 2 = 50,7805$
(I) $51,78 - 2,746 = 49,034$	(III) $49,966 - 0,936 = 49,03$	$H_{4-A} = (49,034 + 49,03) : 2 = 49,032$
$H_{4-B} = 51,78 - 2,491 = 49,289$		
(I) $51,78 - 2,568 = 49,212$	(III) $49,966 - 0,756 = 49,21$	$H_{4-B} = (49,212 + 49,21) : 2 = 49,211$

II

$H_{2-D} = 51,401 - 1,176 = 50,225$	(III) $49,966 - 0,252 = 49,714$	$H_{4-D} = (49,713 + 49,714) : 2 = 49,7135$
(II) $51,401 - 1,688 = 49,713$	$H_{2-E} = 51,401 - 0,945 = 50,456$	$H_{3-E} = 51,401 - 1,477 = 49,924$
$H_{1-D} = 51,401 - 1,215 = 50,186$	$H_{1-E} = 51,401 - 1,147 = 50,254$	$H_{2-E} = 51,401 - 0,620 = 50,781$
$H_{4-D} = 51,401 - 1,510 = 49,891$		
$H_{3-E} = 51,401 - 1,816 = 49,585$	(III) $49,966 - 0,331 = 49,635$	$H_{4-E} = (49,632 + 49,635) : 2 = 49,6335$
(II) $51,401 - 1,769 = 49,632$		

III

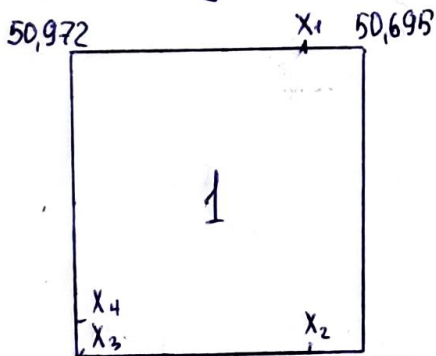
$H_{5-A} = 49,966 - 2,118 = 47,848$	$H_{5-B} = 49,966 - 1,572 = 48,394$	$H_{5-C} = 49,966 - 0,887 = 49,079$
$H_{5-D} = 49,966 - 0,570 = 49,456$	$H_{5-E} = 49,966 - 0,200 = 49,766$	
$H_{6-A} = 49,966 - 0,758 = 49,208$	$H_{6-B} = 49,966 - 0,991 = 48,975$	$H_{6-C} = 49,966 - 0,343 = 49,623$
$H_{6-D} = 49,966 - 0,300 = 49,666$	$H_{6-E} = 49,966 - 0,725 = 49,241$	$H_{6-E} = 49,966 - 0,310 = 49,656$

Таблица

	А	Б	В	Г	Д	Е
1	50,972 1	50,695 2	50,303 3	50,9345 4	50,186 5	50,254
2	51,003 6	50,556 7	50,080 8	50,225 9	50,456 10	50,781
3	49,781 11	49,544 12	49,440 13	50,7805 14	49,924 15	49,585
4	49,032 16	49,289 17	49,211 18	49,7135 19	49,891 20	49,6335
5	47,848 21	48,394 22	49,079 23	49,456 24	49,626 25	49,766
6	49,208	48,975	49,623	49,666	49,241	49,656

Ручная интерполяция

формула для вычисления интерполяции $x_n = \frac{40 \cdot (H_{xn} - H_m)}{(H_5 - H_m)}$

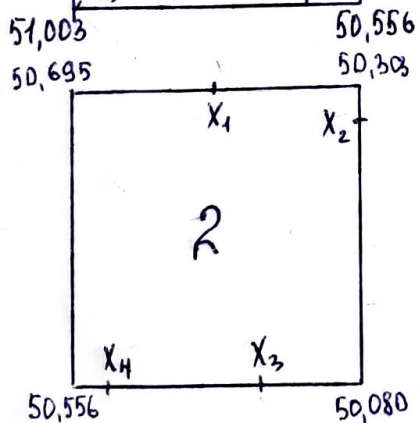


$$x_1 = \frac{40 \cdot (50,75 - 50,695)}{(50,972 - 50,695)} = \frac{2,2}{0,277} = 8$$

$$x_2 = \frac{40 \cdot (50,75 - 50,556)}{(51,003 - 50,556)} = \frac{7,76}{0,447} = 17$$

$$x_3 = \frac{40 \cdot (51 - 50,556)}{(51,003 - 50,556)} = \frac{17,76}{0,447} = 40$$

$$x_4 = \frac{40 \cdot (51 - 50,972)}{(51,003 - 50,972)} = \frac{1,12}{0,031} = 36$$

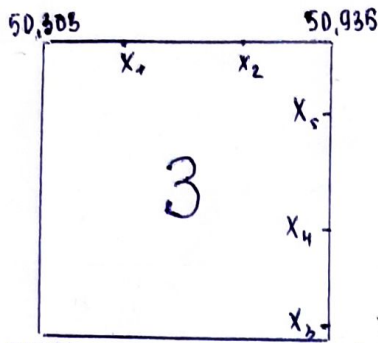


$$x_1 = \frac{40 \cdot (50,5 - 50,303)}{(50,695 - 50,303)} = \frac{7,88}{0,392} = 20$$

$$x_2 = \frac{40 \cdot (50,25 - 50,080)}{(50,303 - 50,080)} = \frac{6,8}{0,223} = 30$$

$$x_3 = \frac{40 \cdot (50,25 - 50,080)}{(50,556 - 50,080)} = \frac{6,8}{0,476} = 14$$

$$x_4 = \frac{40 \cdot (50,5 - 50,080)}{(50,556 - 50,080)} = \frac{16,8}{0,476} = 35$$



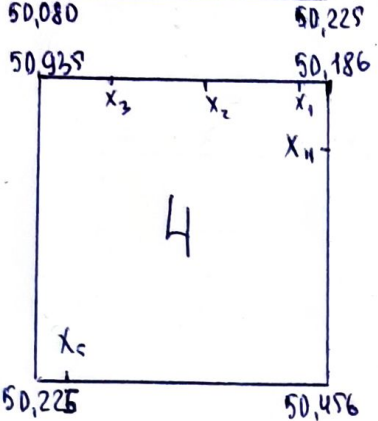
$$x_1 = \frac{40(50,5 - 50,303)}{(50,935 - 50,303)} = \frac{7,88}{0,632} = 12$$

$$x_2 = \frac{40(50,75 - 50,303)}{(50,935 - 50,303)} = \frac{17,88}{0,632} = 28$$

$$x_3 = \frac{40(50,25 - 50,225)}{(50,935 - 50,225)} = \frac{1}{0,71} = 1$$

$$x_4 = \frac{40(50,5 - 50,225)}{(50,935 - 50,225)} = \frac{11}{0,71} = 15$$

$$x_5 = \frac{40(50,75 - 50,225)}{(50,935 - 50,225)} = \frac{21}{0,71} = 30$$



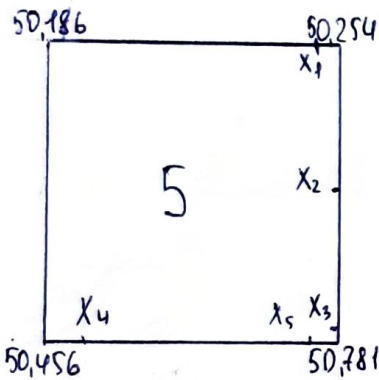
$$x_1 = \frac{40(50,25 - 50,186)}{(50,935 - 50,186)} = \frac{2,56}{0,749} = 3$$

$$x_2 = \frac{40(50,5 - 50,186)}{(50,935 - 50,186)} = \frac{12,56}{0,749} = 17$$

$$x_3 = \frac{40(50,75 - 50,186)}{(50,935 - 50,186)} = \frac{22,56}{0,749} = 30$$

$$x_4 = \frac{40(50,25 - 50,186)}{(50,456 - 50,186)} = \frac{2,56}{0,27} = 9$$

$$x_5 = \frac{40(50,25 - 50,225)}{(50,456 - 50,225)} = \frac{1}{0,231} = 4$$



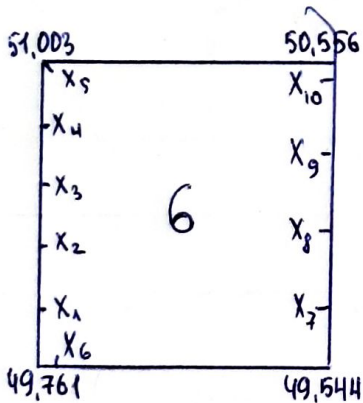
$$x_1 = \frac{40(50,25 - 50,186)}{(50,254 - 50,186)} = \frac{2,56}{0,068} = 38$$

$$x_2 = \frac{40(50,5 - 50,254)}{(50,781 - 50,254)} = \frac{9,84}{0,527} = 19$$

$$x_3 = \frac{40(50,75 - 50,254)}{(50,781 - 50,254)} = \frac{19,84}{0,527} = 38$$

$$x_4 = \frac{40(50,5 - 50,456)}{(50,781 - 50,456)} = \frac{1,76}{0,325} = 5$$

$$x_5 = \frac{40(50,75 - 50,456)}{(50,781 - 50,456)} = \frac{11,76}{0,325} = 36$$



$$x_1 = \frac{40(50 - 49,761)}{(51,003 - 49,761)} = \frac{9,56}{1,242} = 8$$

$$x_2 = \frac{40(50,25 - 49,761)}{(51,003 - 49,761)} = \frac{19,56}{1,242} = 16$$

$$x_3 = \frac{40(50,5 - 49,761)}{(51,003 - 49,761)} = \frac{29,56}{1,242} = 24$$

$$x_4 = \frac{40(50,75 - 49,761)}{(51,003 - 49,761)} = \frac{39,56}{1,242} = 32$$

$$x_5 = \frac{40(51 - 49,761)}{(51,003 - 49,761)} = \frac{49,56}{1,242} = 40$$

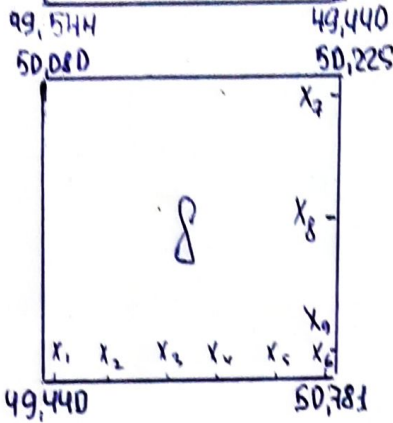
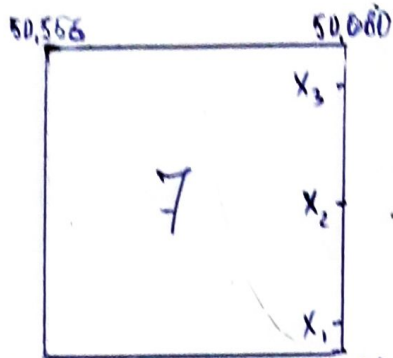
$$x_6 = \frac{40(49,75 - 49,544)}{(49,761 - 49,544)} = \frac{8,24}{0,217} = 38$$

$$x_7 = \frac{40(49,75 - 49,544)}{(50,556 - 49,544)} = \frac{8,24}{1,012} = 8$$

$$x_8 = \frac{40(50 - 49,544)}{(50,556 - 49,544)} = \frac{18,24}{1,012} = 18$$

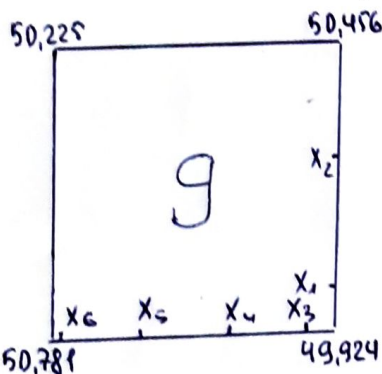
$$x_9 = \frac{40(50,25 - 49,544)}{(50,556 - 49,544)} = \frac{28,24}{1,012} = 28$$

$$x_{10} = \frac{40(50,5 - 49,544)}{(50,556 - 49,544)} = \frac{38,24}{1,012} = 38$$



$$X_8 = \frac{40(50,5 - 50,225)}{50,781 - 50,225} = \frac{11}{0,556} = 20$$

$$X_9 = \frac{40(50,75 - 50,225)}{50,781 - 50,225} = \frac{21}{0,556} = 38$$



$$X_1 = \frac{40(49,5 - 49,440)}{(50,080 - 49,440)} = \frac{2,4}{0,64} = 4$$

$$X_2 = \frac{40(49,75 - 49,440)}{(50,080 - 49,440)} = \frac{12,4}{0,64} = 19$$

$$X_3 = \frac{40(50 - 49,440)}{(50,080 - 49,440)} = \frac{22,4}{0,64} = 35$$

$$X_4 = \frac{40(49,5 - 49,440)}{(49,544 - 49,440)} = \frac{2,4}{0,104} = 23$$

$$X_1 = \frac{40(49,5 - 49,440)}{50,781 - 49,440} = \frac{2,4}{1,341} = 2$$

$$X_2 = \frac{40(49,75 - 49,440)}{50,781 - 49,440} = \frac{12,4}{1,341} = 9$$

$$X_3 = \frac{40(50 - 49,440)}{50,781 - 49,440} = \frac{22,4}{1,341} = 17$$

$$X_4 = \frac{40(50,25 - 49,440)}{50,781 - 49,440} = \frac{32,4}{1,341} = 24$$

$$X_5 = \frac{40(50,5 - 49,440)}{50,781 - 49,440} = \frac{42,4}{1,341} = 32$$

$$X_6 = \frac{40(50,75 - 49,440)}{50,781 - 49,440} = \frac{52,4}{1,341} = 39$$

$$X_7 = \frac{40(50,25 - 50,225)}{50,781 - 50,225} = \frac{1}{0,556} = 2$$

$$X_1 = \frac{40(50 - 49,924)}{50,456 - 49,924} = \frac{3,04}{0,532} = 6$$

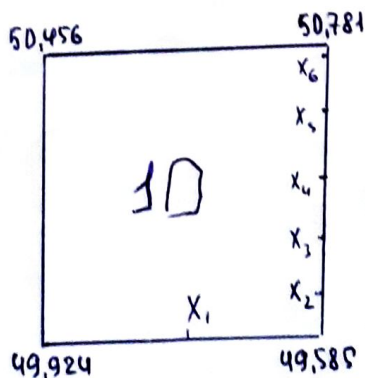
$$X_2 = \frac{40(50,25 - 49,924)}{50,456 - 49,924} = \frac{13,04}{0,532} = 24$$

$$X_3 = \frac{40(50 - 49,924)}{50,781 - 49,924} = \frac{3,04}{0,857} = 4$$

$$X_4 = \frac{40(50,25 - 49,924)}{50,781 - 49,924} = \frac{13,04}{0,857} = 15$$

$$X_5 = \frac{40(50,5 - 49,924)}{50,781 - 49,924} = \frac{23,04}{0,857} = 27$$

$$X_6 = \frac{40(50,75 - 49,924)}{50,781 - 49,924} = \frac{33,04}{0,857} = 39$$



$$X_1 = \frac{40(49,75 - 49,585)}{49,924 - 49,585} = \frac{6,6}{0,339} = 19$$

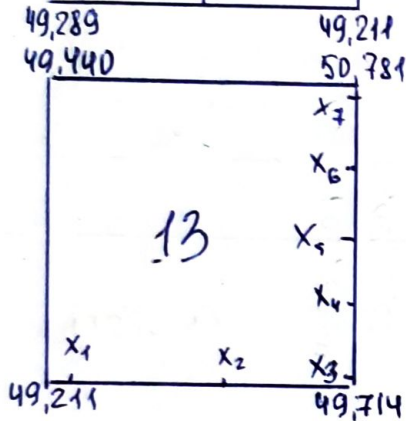
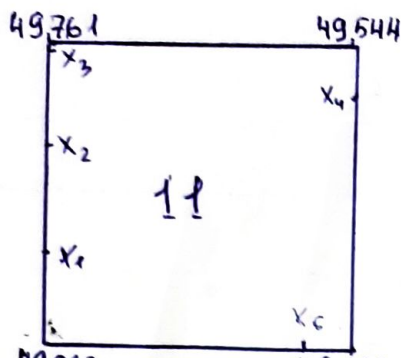
$$X_2 = \frac{40(49,75 - 49,585)}{50,781 - 49,585} = \frac{6,6}{1,196} = 6$$

$$X_3 = \frac{40(50 - 49,585)}{50,781 - 49,585} = \frac{16,6}{1,196} = 14$$

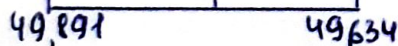
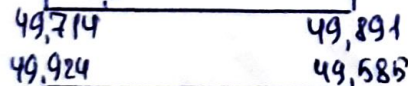
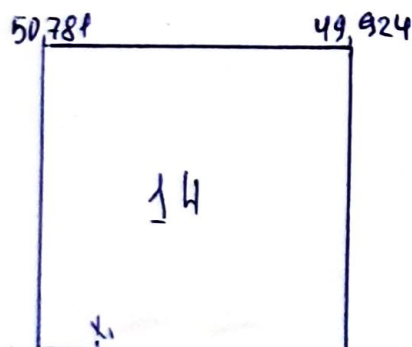
$$X_4 = \frac{40(50,25 - 49,585)}{50,781 - 49,585} = \frac{26,6}{1,196} = 22$$

$$X_5 = \frac{40(50,5 - 49,585)}{50,781 - 49,585} = \frac{36,6}{1,196} = 31$$

$$X_6 = \frac{40(50,75 - 49,585)}{50,781 - 49,585} = \frac{46,6}{1,196} = 39$$



$$x_7 = \frac{40(50,781 - 49,714)}{(50,781 - 49,714)} = \frac{41,44}{1,067} = 39$$



$$x_1 = \frac{40(49,25 - 49,032)}{(49,761 - 49,032)} = \frac{8,72}{0,729} = 12$$

$$x_2 = \frac{40(49,5 - 49,032)}{(49,761 - 49,032)} = \frac{18,72}{0,729} = 26$$

$$x_3 = \frac{40(49,75 - 49,032)}{(49,761 - 49,032)} = \frac{28,72}{0,729} = 39$$

$$x_4 = \frac{40(49,5 - 49,289)}{(49,544 - 49,289)} = \frac{8,44}{0,255} = 33$$

$$x_5 = \frac{40(49,25 - 49,032)}{(49,289 - 49,032)} = \frac{8,72}{0,257} = 34$$

$$x_1 = \frac{40(49,25 - 49,211)}{(49,289 - 49,211)} = \frac{1,56}{0,078} = 20$$

$$x_2 = \frac{40(49,25 - 49,211)}{(49,440 - 49,211)} = \frac{1,56}{0,229} = 7$$

$$x_1 = \frac{40(49,25 - 49,211)}{(49,714 - 49,211)} = \frac{1,56}{0,503} = 3$$

$$x_2 = \frac{40(49,5 - 49,211)}{(49,714 - 49,211)} = \frac{11,56}{0,503} = 23$$

$$x_3 = \frac{40(49,75 - 49,714)}{(50,781 - 49,714)} = \frac{1,44}{1,067} = 1$$

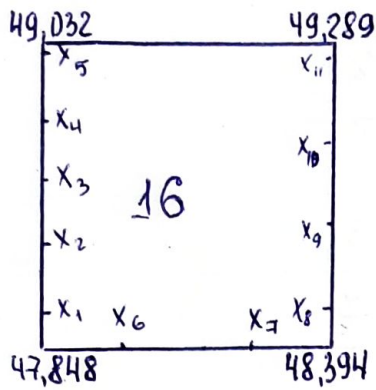
$$x_4 = \frac{40(50 - 49,714)}{(50,781 - 49,714)} = \frac{11,44}{1,067} = 11$$

$$x_5 = \frac{40(50,25 - 49,714)}{(50,781 - 49,714)} = \frac{21,44}{1,067} = 20$$

$$x_6 = \frac{40(50,5 - 49,714)}{(50,781 - 49,714)} = \frac{31,44}{1,067} = 29$$

$$x_1 = \frac{40(49,75 - 49,714)}{(49,891 - 49,714)} = \frac{1,44}{0,177} = 8$$

$$x_1 = \frac{40(49,75 - 49,634)}{(49,891 - 49,634)} = \frac{4,64}{0,257} = 18$$



$$x_{10} = \frac{40(49 - 48,394)}{(49,289 - 48,394)} = \frac{24,24}{0,895} = 27$$

$$x_{11} = \frac{40(49,25 - 48,394)}{(49,289 - 48,394)} = \frac{34,24}{0,895} = 38$$

$$x_1 = \frac{40(48 - 47,848)}{(49,032 - 47,848)} = \frac{6,08}{1,184} = 5$$

$$x_2 = \frac{40(48,25 - 47,848)}{(49,032 - 47,848)} = \frac{16,08}{1,184} = 14$$

$$x_3 = \frac{40(48,5 - 47,848)}{(49,032 - 47,848)} = \frac{26,08}{1,184} = 22$$

$$x_4 = \frac{40(48,75 - 47,848)}{(49,032 - 47,848)} = \frac{36,08}{1,184} = 30$$

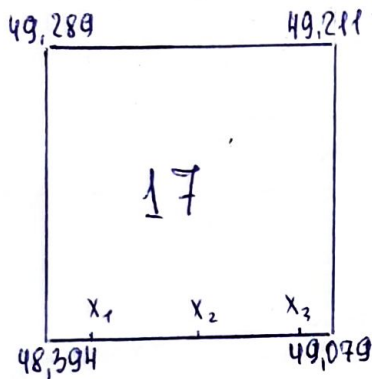
$$x_5 = \frac{40(49 - 47,848)}{(49,032 - 47,848)} = \frac{46,08}{1,184} = 39$$

$$x_6 = \frac{40(48 - 47,848)}{(48,394 - 47,848)} = \frac{6,08}{0,546} = 11$$

$$x_7 = \frac{40(48,25 - 47,848)}{(48,394 - 47,848)} = \frac{16,08}{0,546} = 29$$

$$x_8 = \frac{40(48,5 - 48,394)}{(-48,394 + 49,289)} = \frac{4,24}{0,895} = 5$$

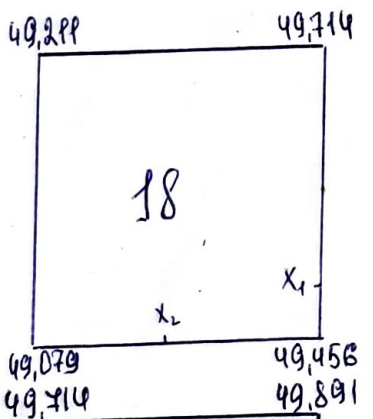
$$x_9 = \frac{40(48,75 - 48,394)}{(49,289 - 48,394)} = \frac{14,24}{0,895} = 16$$



$$x_1 = \frac{40(48,5 - 48,394)}{(49,079 - 48,394)} = \frac{4,24}{0,685} = 6$$

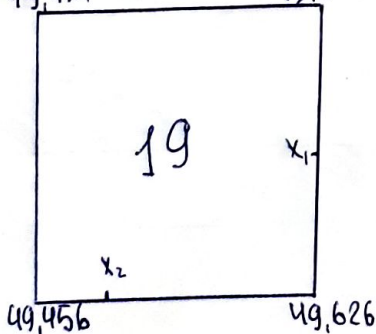
$$x_2 = \frac{40(48,75 - 48,394)}{(49,079 - 48,394)} = \frac{14,24}{0,685} = 21$$

$$x_3 = \frac{40(49 - 48,394)}{(49,079 - 48,394)} = \frac{24,24}{0,685} = 35$$



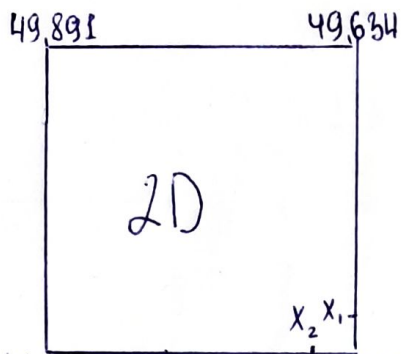
$$x_1 = \frac{40(49,5 - 49,456)}{(49,714 - 49,456)} = \frac{1,76}{0,258} = 7$$

$$x_2 = \frac{40(49,25 - 49,079)}{(49,456 - 49,079)} = \frac{6,84}{0,377} = 18$$



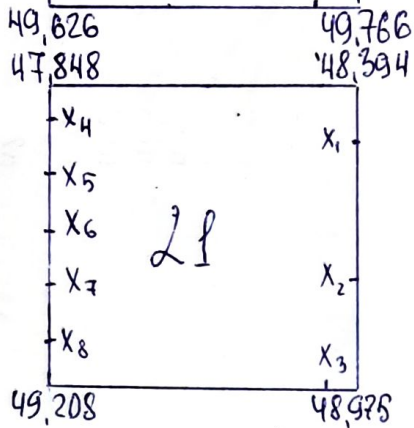
$$x_1 = \frac{40(49,75 - 49,626)}{(49,891 - 49,626)} = \frac{4,96}{0,265} = 19$$

$$x_2 = \frac{40(49,5 - 49,456)}{(49,626 - 49,456)} = \frac{1,76}{0,17} = 10$$



$$x_1 = \frac{40 \cdot (49,75 - 49,634)}{(49,766 - 49,634)} = \frac{4,64}{0,132} = 35$$

$$x_2 = \frac{40 \cdot (49,75 - 49,626)}{(49,766 - 49,626)} = \frac{4,96}{0,14} = 35$$



$$x_1 = \frac{40(48,5 - 48,394)}{(48,975 - 48,394)} = \frac{4,24}{0,581} = 7$$

$$x_2 = \frac{40(48,75 - 48,394)}{(48,975 - 48,394)} = \frac{14,24}{0,581} = 25$$

$$x_3 = \frac{40(49 - 48,975)}{(49,208 - 48,975)} = \frac{1}{0,233} = 4$$

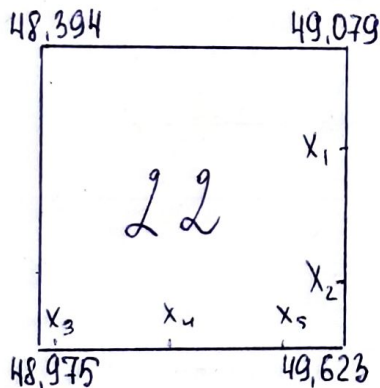
$$x_4 = \frac{40(48 - 47,848)}{(49,208 - 47,848)} = \frac{6,08}{1,36} = 4$$

$$x_5 = \frac{40(48,25 - 47,848)}{(49,208 - 47,848)} = \frac{16,08}{1,36} = 12$$

$$x_6 = \frac{40(48,5 - 47,848)}{(49,208 - 47,848)} = \frac{26,08}{1,36} = 19$$

$$x_7 = \frac{40(48,75 - 47,848)}{(49,208 - 47,848)} = \frac{36,08}{1,36} = 27$$

$$x_8 = \frac{40(49 - 47,848)}{(49,208 - 47,848)} = \frac{46,08}{1,36} = 34$$



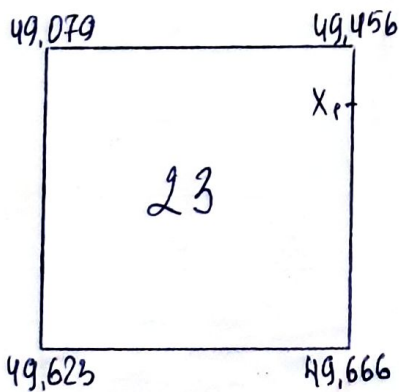
$$x_1 = \frac{40(49,25 - 49,079)}{(49,623 - 49,079)} = \frac{6,84}{0,544} = 13$$

$$x_2 = \frac{40(49,5 - 49,079)}{(49,623 - 49,079)} = \frac{16,84}{0,544} = 31$$

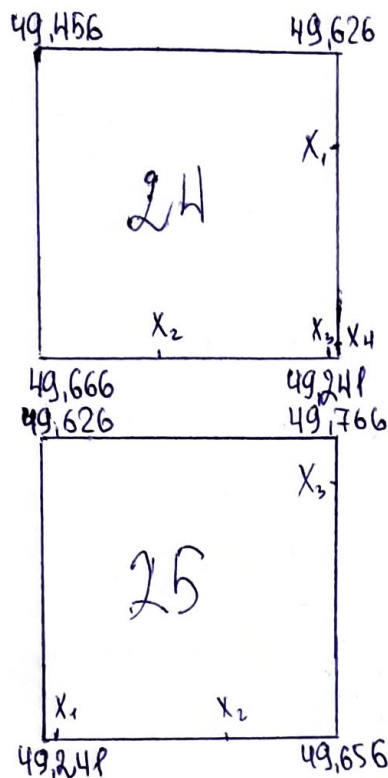
$$x_3 = \frac{40(49 - 48,975)}{(49,623 - 48,975)} = \frac{1}{0,648} = 2$$

$$x_4 = \frac{40(49,25 - 48,975)}{(49,623 - 48,975)} = \frac{11}{0,648} = 17$$

$$x_5 = \frac{40(49,5 - 48,975)}{(49,623 - 48,975)} = \frac{21}{0,648} = 32$$



$$x_1 = \frac{40(49,5 - 49,456)}{(49,666 - 49,456)} = \frac{1,76}{0,21} = 8$$



$$X_1 = \frac{40(49,5 - 49,241)}{(49,626 - 49,241)} = \frac{10,36}{0,385} = 24$$

$$X_2 = \frac{40(49,5 - 49,241)}{(49,666 - 49,241)} = \frac{10,36}{0,425} = 24$$

$$X_3 = \frac{40(49,25 - 49,241)}{(49,666 - 49,241)} = \frac{0,36}{0,425} = 1$$

$$X_4 = \frac{40(49,25 - 49,241)}{(49,626 - 49,241)} = \frac{0,36}{0,385} = 1$$

$$X_1 = \frac{40(49,25 - 49,241)}{(49,656 - 49,241)} = \frac{0,36}{0,415} = 1$$

$$X_2 = \frac{40(49,5 - 49,241)}{(49,656 - 49,241)} = \frac{10,36}{0,415} = 25$$

$$X_3 = \frac{40(49,75 - 49,656)}{(49,766 - 49,656)} = \frac{3,76}{0,11} = 34$$

Вывод: При построении топографического плана местности с помощью отметки репера, выясняется, что рельеф разнообразен. На данном участке местности в основном преобладают небольшие возвышения и низменности.

