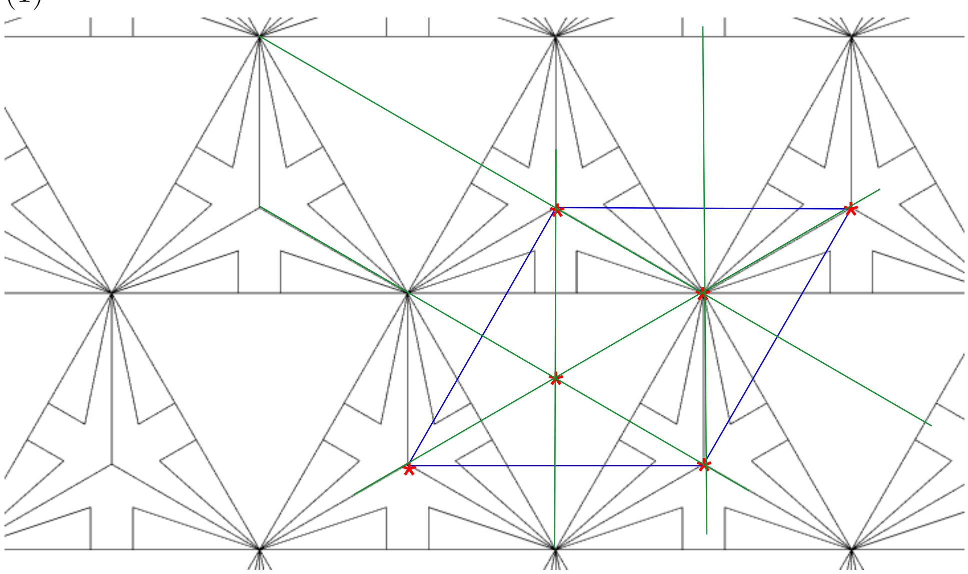
Math 331 **Exam 3 Solutions** **Spring '06**

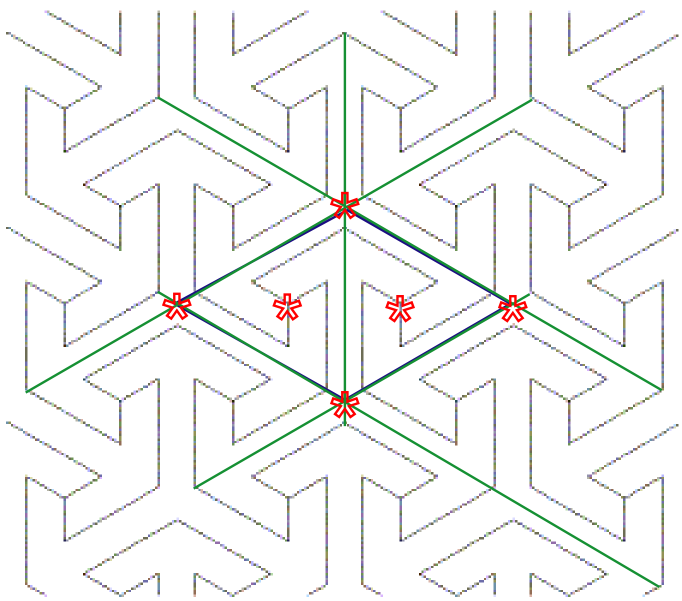
The following are wallpaper patterns. For each one, do the following:

(a) Draw a rhombic or rectangular fundamental region for the translations. If there are 6-centers in the pattern, base your fundamental region at a 6-center. If there are 4-centers in the pattern, base your fundamental region at a 4-center. If the only centers are 3-centers, and if there are lines of symmetry, base your fundamental region at a 3-center on a line of symmetry.
(b) Indicate all centers in the fundamental region (including its boundary). Use a color code or shape code to show what kind of center it is.
(c) Draw in all lines of symmetry that meet the fundamental region (including its boundary) in more than one point.
(d) If there is a glide reflection but no reflections, indicate the axis of the glide reflection by a dashed line.
(e) Write the name of the group below the pattern.

(1)

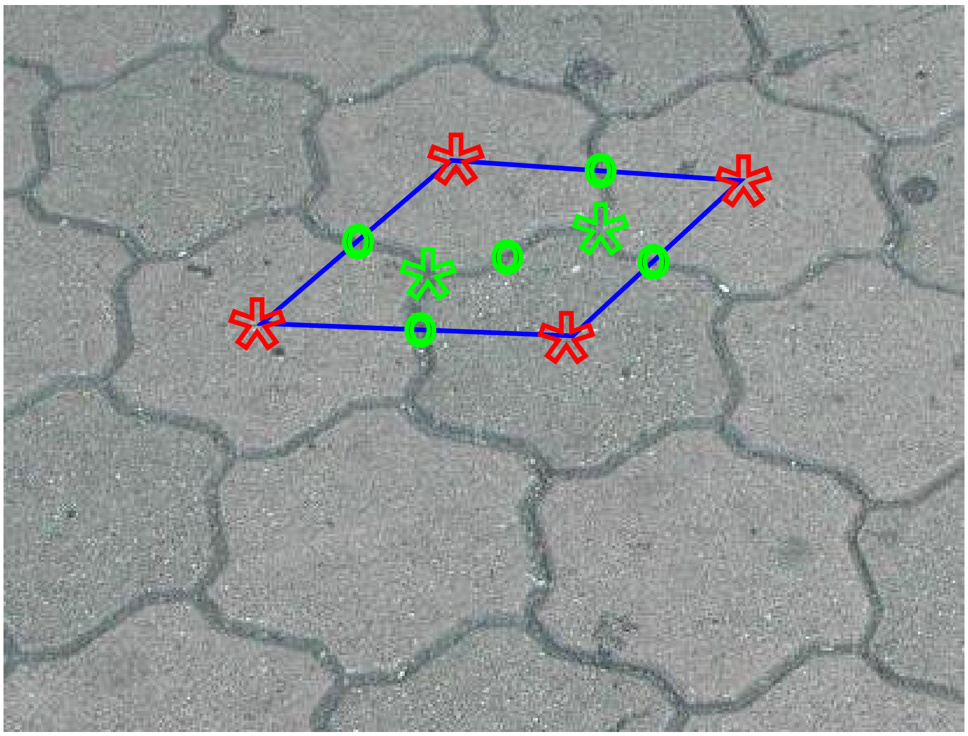


Here, the blue lines bound the fundamental region for translations. The green lines are lines of symmetry. The red asterisks are 3-centers. The group is $\mathcal{W}_3^1$.

(2) 

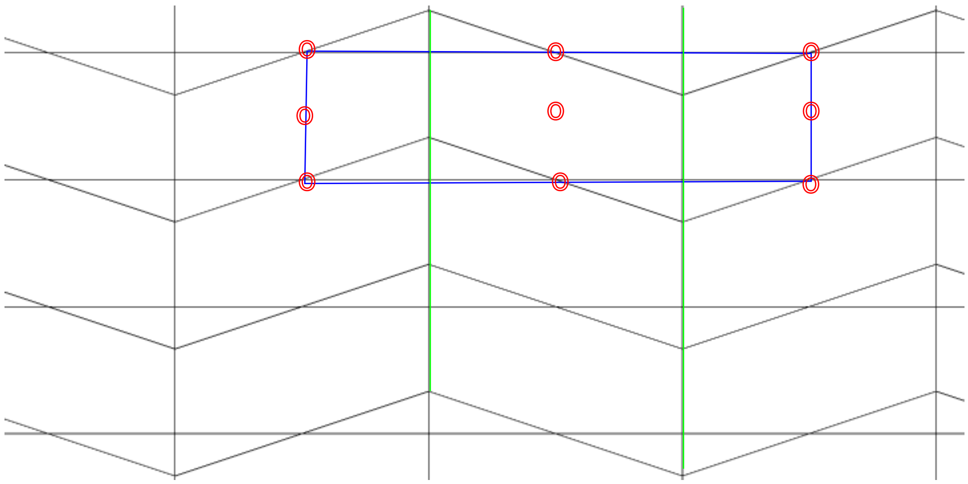
Here, the blue lines bound the fundamental region for translations. The green lines are lines of symmetry. The red asterisks are 3-centers. The group is $\mathcal{W}_3^2$.

(3)



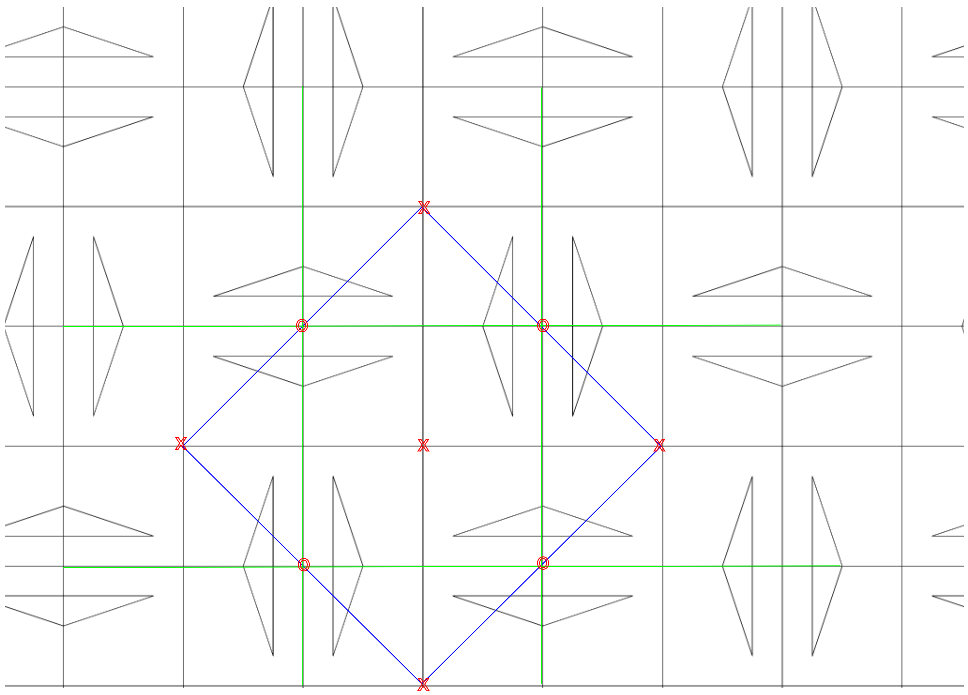
Here, the blue lines bound the fundamental region for translations. There are no lines of symmetry. The red asterisks are 6-centers. The green asterisks are 3-centers. The green o's are 2-centers. The group is $\mathcal{W}_6$.

(4)



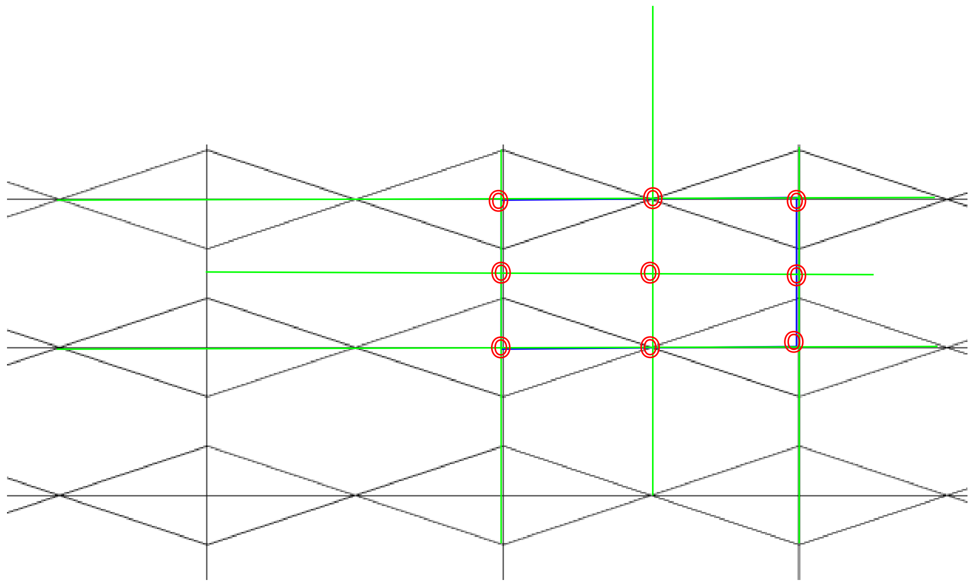
Here, the blue lines bound the fundamental region for translations. The green lines are lines of symmetry. The red o's are 2-centers. The group is $\mathcal{W}_2^3$.

(5)



Here, the blue lines bound the fundamental region for translations. The green lines are lines of symmetry. The red x's are 4-centers. The red o's are 2-centers. The group is $\mathcal{W}_4^2$.

(6)



Here, the blue lines bound the fundamental region for translations. The green lines are lines of symmetry. The red o's are 2-centers. The group is $\mathcal{W}_2^2$.