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Reef Area Calculations

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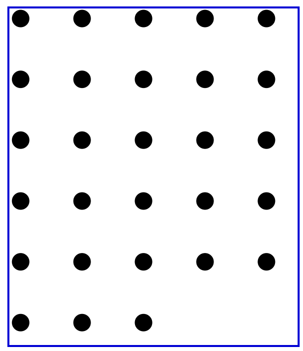
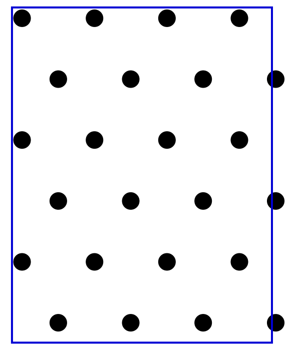
The problem is to make it easy to calculate the number of artificial reefs in a given area and the area required for a given number of reefs of known sizes and spacing. Unknown parameters may be X'd out.

Parameter	*amount*	*unit*
Number:	100000	reefs
Diameter:	1	m
Spacing:	3	m
Width:	20	m
Length:	22	m
Area:	X	sq m

rtificial Reef Deployment Pattern





Calculations **Rectangular Pattern** **Triangular Pattern**

We need to calculate some paramters from the above given parameters. We start with the number of reefs of given diameter and spacing in a rectangular pattern that can be wholly contained in a given rectangle.

Centers:	4	m	
Width:	5.75	reefs/row	
Length:	6.25	reefs/col	
Number:	30	reefs	wholly contained in a rectangular area

Then we need to calculate the minimum square area required to wholly contain a given number of reefs of given diameter and spacing. As the number of reefs may not be square, we assume the last two rows may be incomplete.

Width:	317	reefs/side	
= Side of square:	**1265**	m	side of square that contains the given reefs
Unused slots:	489	reefs	number of reefs that could be added to same plot

The triangular pattern is a closer packing because the rows are closer together. The rows remain straight, so deployment remains easy. The calculations are just a little harder.

Equilateral Length:	0.866	side	altitude of a unit equilateral triangle
Row-to-row:	3.4641	m	by Pythagoras
Length:	7.2169	reefs/col	that is, the number of rows
Number:	35	reefs	wholly contained in a triangular area

We again need to calculate the minimum square area required to wholly contain a given number of reefs of given diameter and spacing, but in a triangular pattern. The calculations are complicated by trying to fit a triangular pattern into a square or rectangle.

Number(Width):	? reefs	number of reefs in given rectangle
Width(Number):	? reefs	number of reefs from corner to opposite corner
Unused slots:	? reefs	number of reefs that could be added to same plot
Diameter:	? m	outside distance from corner to opposite corner

Placing a triangular pattern in a hexagonal box makes it more symmetric and easier to calculate. A hexagonal box fits nicely into a circular area. We proceed by inverting the function that maps width *W* in reefs into number *A* of reefs.

The source uses the radius N in half steps. We want the width = diameter W = 2N-1 in whole steps, so N = (W+1)/2. The calculations are simpler than those in the source:

$A = 3N^2-3N+1 = (W^2-1)*3/4+1$ for odd W

$A = 3(N-1/2)^2 = W^2*3/4$ for even W

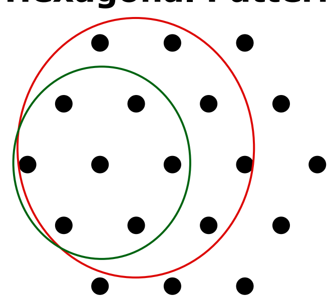
Both are easily combined, with low order bit b=W%1:

$A = (W^2-b)*3/4+b = (3W^2+b)/4$

The inverse is then:

$W = \text{ceiling} \sqrt{(A*4-1)/3}$

Hexagonal Pattern

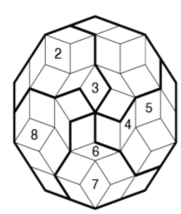


Google 1 3 7 12 19 27 37 48 61

source: http://mrob.com/pub/math/numbers-8.html

Number(Width):	300 reefs	number of reefs in given hexagon
Width(Number):	366 reefs	number of reefs from corner to opposite corner
Unused slots:	467 reefs	number of reefs that could be added to same plot
Diameter:	1865 m	outside distance from corner to opposite corner

One problem with both rectangular and triangular patterns is that they have long straight avenues. Is that good or bad? If bad, we may want to try some aperiodic patterns, such as Penrose tilings with reef a at the vertices. The avenues crossing parallel edges are all curved.The pattern can be extended indefinitely without repeating.



source: http://onigame.livejournal.com/38017.html

Number(Width):	? reefs	number of reefs in given hexagon
Width(Number):	? reefs	number of reefs from corner to opposite corner
Unused slots:	? reefs	number of reefs that could be added to same plot

Diameter:	? m	outside distance from corner to opposite corner

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