

# Package ‘diamonds’

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**Title** Analysis and sampling grids from diamond partitions

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**Description** Functions for illustrating aperture-4 diamond partitions in the plane, or on the surface of an octahedron or icosahedron, for use as analysis or sampling grids.

**License** Unlimited

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`diamond.base`*Create a base diamond*

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**Description**

Generates vertices of a portrait format diamond with center at (x, y) and short axis d.

**Usage**

```
diamond.base (x=0, y=0, a=1)
```

**Arguments**

x	x coordinate of diamond center
y	y coordinate of diamond center
a	length of short axis of diamond

**Details**

This function is normally called first to establish a base diamond from which recursive partitions are derived. The partitions are created from 4-fold subdivision into  $4^{(d-1)}$  congruent sub-diamonds.

A "diamond" in this package means the figure formed by two equilateral triangles connected across a common edge, or, two adjacent faces of an octahedron or icosahedron.

Recursion in this package limits the useful size of problem. A version with C routines is in development.

**Value**

A list with four components, each a pair of (x, y) coordinates describing a vertex of the diamond.

**Author(s)**

Denis White, <white.denis@epa.gov>

**References**

White, D., (2000) Global grids from recursive diamond subdivisions of the surface of an octahedron or icosahedron, *Environmental Monitoring and Assessment*, **64**(1), 93-103.

**Examples**

```
base <- diamond.base ()

diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4))

# kites for levels 2-4
```

```
diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4), lwd=1, col="blue")
lines (diamond.triedges (base, 4), lwd=1, col="blue")
lines (diamond.dualedges (base, 4), lwd=1, col="blue")
lines (diamond.edges (base, 3), lwd=2, col="green")
lines (diamond.triedges (base, 3), lwd=2, col="green")
lines (diamond.dualedges (base, 3), lwd=2, col="green")
lines (diamond.edges (base, 2), lwd=3, col="red")
lines (diamond.triedges (base, 2), lwd=3, col="red")
lines (diamond.dualedges (base, 2), lwd=3, col="red")
lines (diamond.edges (base, 1), lwd=2, col="black")
title ("'Kites' for Levels 2-4", line=0)
```

---

diamond.centers

*Coordinates of centers of diamonds*

---

## Description

Creates x and y coordinates of center points of a diamond partition, suitable for [points](#).

## Usage

```
diamond.centers (b, d)
```

## Arguments

b list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d depth of recursion of partition; if d=1, then no partition

## Value

List with x and y components.

## Author(s)

Denis White, <[white.denis@epa.gov](mailto:white.denis@epa.gov)>

## Examples

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
points (diamond.centers (base, 4), pch=19, col="red")
lines (diamond.edges (base, 1), lwd=2, col="black")
title ("Diamond Centers at Level 4", line=0)
```

---

diamond.dualcents      *Coordinates of centers of hexagons*

---

### Description

Creates x and y coordinates of center points of the hexagon duals of a diamond partition, suitable for [points](#).

### Usage

```
diamond.dualcents (b, d)
```

### Arguments

b                      list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d                      depth of recursion of partition; if d=1, then no partition

### Details

Centers are generated for "left-side" hexagons, assuming that diamonds are joined as in octahedron or icosahedron. See reference.

### Value

List with x and y components.

### Author(s)

Denis White, <[white.denis@epa.gov](mailto:white.denis@epa.gov)>

### References

White, D., (2000) Global grids from recursive diamond subdivisions of the surface of an octahedron or icosahedron, *Environmental Monitoring and Assessment*, **64**(1), 93-103.

### Examples

```
base <- diamond.base ()  
diamond.plot (diamond.edges (base, 1))  
lines (diamond.dualedges (base, 4), col="blue")  
points (diamond.dualcents (base, 4), pch=19, col="red")  
lines (diamond.edges (base, 1), lwd=2, col="black")  
title ("Centers of Dual Hexagons at Level 4", line=0)
```

---

diamond.dualedges      *Coordinates of edges of hexagons*

---

**Description**

Creates x and y coordinates of edges of the hexagon duals of a diamond partition, suitable for [lines](#).

**Usage**

```
diamond.dualedges (b, d)
```

**Arguments**

b                      list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d                      depth of recursion of partition; if d=1, then no partition

**Value**

List with x and y components.

**Author(s)**

Denis White, <[white.denis@epa.gov](mailto:white.denis@epa.gov)>

**Examples**

```
base <- diamond.base ()  
diamond.plot (diamond.edges (base, 1))  
lines (diamond.dualedges (base, 4), col="blue")  
lines (diamond.edges (base, 1), lwd=2, col="black")  
title ("Dual Hexagons at Level 4", line=0)
```

---

diamond.edges              *Coordinates of edges of diamonds*

---

**Description**

Creates x and y coordinates of edges of a diamond partition, suitable for [lines](#).

**Usage**

```
diamond.edges (b, d)
```

**Arguments**

b                      list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d                      depth of recursion of partition; if d=1, then no partition

**Value**

List with x and y components.

**Author(s)**

Denis White, <white.denis@epa.gov>

**Examples**

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4))
lines (diamond.edges (base, 1), lwd=2)
title ("Diamond Partition at Level 4", line=0)
```

---

diamond.hierwalk	<i>Coordinates of hierarchical walk</i>
------------------	---

---

**Description**

Creates x and y coordinates of paths connecting centers, in hierarchical order, of a diamond partition, suitable for [lines](#).

**Usage**

```
diamond.hierwalk (b, d)
```

**Arguments**

b list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d depth of recursion of partition; if d=1, then no partition

**Details**

The walk connects diamonds in the partition in the order of the labels generated by [diamond.labels](#). That is, the walk describes the Morton or Peano sequence of traverse across the partition.

**Value**

List with x and y components.

**Author(s)**

Denis White, <white.denis@epa.gov>

**See Also**

[diamond.labels](#), [diamond.randwalk](#)

## Examples

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
points (diamond.centers (base, 4), pch=19, col="red")
lines (diamond.hierwalk (base, 4), lwd=1, col="blue")
lines (diamond.edges (base, 1), lwd=2, col="black")
title ("Hierarchical Walk at Level 4", line=0)
```

---

diamond.labels	<i>Labels for a diamond partition</i>
----------------	---------------------------------------

---

## Description

Creates a vector of character labels for diamonds in a partition.

## Usage

```
diamond.labels (d)
```

## Arguments

d                      depth of recursion of partition; if d=1, then no partition

## Details

The labels are generated from a quadrant-recursive ordering, see reference.

## Value

A vector of character labels for each diamond in the partition.

## Author(s)

Denis White, <white.denis@epa.gov>

## References

White, D., (2000) Global grids from recursive diamond subdivisions of the surface of an octahedron or icosahedron, *Environmental Monitoring and Assessment*, **64**(1), 93-103.

## See Also

[diamond.hierwalk](#), [diamond.randlabels](#)

## Examples

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4), lwd=1, col="blue")
lines (diamond.edges (base, 1), lwd=2, col="black")
text (diamond.centers (base, 4), diamond.labels (4))
title ("Morton/Peano Numbers at Level 4", line=0)
```

---

diamond.plot

*Define a fixed aspect ratio plot*

---

## Description

Calls `plot` to create a plot space whose dimensions are defined by the parameters, and whose aspect ratio is fixed with respect to them.

## Usage

```
diamond.plot (cl)
```

## Arguments

`cl` a list of coordinates with components `x` and `y`, such as returned by `diamond.edges`

## Details

This function calls `plot` with `type="n"`, and it maintains the aspect ratio of the input coordinates in the output graphic by setting `par(pin=)`, thus the map does not scale dynamically in an on-screen window.

## Author(s)

Denis White, <white.denis@epa.gov>

## Examples

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4))
lines (diamond.edges (base, 1), lwd=2)
title ("Diamond Partition at Level 4", line=0)
```

---

diamond.randlabels      *Labels for a hierarchically randomized partition*

---

**Description**

Creates a vector of character labels for diamonds in a partition, where the labels are randomly permuted.

**Usage**

```
diamond.randlabels (d)
```

**Arguments**

d                      depth of recursion of partition; if d=1, then no partition

**Details**

The labels are generated from a quadrant-recursive ordering, then randomly permuted at each level in the recursive hierarchy, see reference.

**Value**

A vector of the hierarchically randomized character labels for each diamond in the partition.

**Author(s)**

Denis White, <white.denis@epa.gov>

**References**

White, D., (2000) Global grids from recursive diamond subdivisions of the surface of an octahedron or icosahedron, *Environmental Monitoring and Assessment*, **64**(1), 93-103.

**See Also**

[diamond.randwalk](#), [diamond.labels](#)

**Examples**

```
diamond.randlabels (2)
```

diamond.randpts      *Coordinates of random points*

---

### Description

Creates x and y coordinates of random points in each diamond element of a diamond partition, suitable for [points](#).

### Usage

```
diamond.randpts (b, d)
```

### Arguments

b                    list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d                    depth of recursion of partition; if d=1, then no partition

### Value

List with x and y components.

### Author(s)

Denis White, <[white.denis@epa.gov](mailto:white.denis@epa.gov)>

### Examples

```
base <- diamond.base ()  
diamond.plot (diamond.edges (base, 1))  
lines (diamond.edges (base, 4), lwd=1, col="blue")  
lines (diamond.edges (base, 1), lwd=2, col="black")  
points (diamond.randpts (base, 4), pch=19, col="red")  
title ("Random Points at Level 4", line=0)
```

---

diamond.randwalk      *Coordinates of hierarchical random walk*

---

### Description

Creates x and y coordinates of paths connecting centers, in random hierarchical order, of a diamond partition, suitable for [lines](#).

### Usage

```
diamond.randwalk (b, d)
```

**Arguments**

- b list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d depth of recursion of partition; if d=1, then no partition

**Details**

The walk connects diamonds in the partition in the order of the labels generated by [diamond.labels](#), except that, at each hierarchical level, the four elements are randomly permuted.

**Value**

List with x and y components.

**Author(s)**

Denis White, <[white.denis@epa.gov](mailto:white.denis@epa.gov)>

**See Also**

[diamond.randlabels](#), [diamond.hierwalk](#)

**Examples**

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
points (diamond.centers (base, 4), pch=19, col="red")
lines (diamond.randwalk (base, 4), lwd=1, col="blue")
lines (diamond.edges (base, 1), lwd=2, col="black")
title ("Hierarchical Random Walk at Level 4", line=0)
```

---

diamond.triedges      *Coordinates of edges of triangles*

---

**Description**

Creates x and y coordinates of bisecting edges of diamonds in partition, providing for two equilateral triangles, with output suitable for [lines](#).

**Usage**

```
diamond.triedges (b, d)
```

**Arguments**

- b list of coordinates of vertices of a diamond, as from [diamond.base](#)  
d depth of recursion of partition; if d=1, then no partition

**Details**

Both this function and `diamond.edges` are necessary to show triangle partitions. See example.

**Value**

List with x and y components.

**Author(s)**

Denis White, <white.denis@epa.gov>

**Examples**

```
base <- diamond.base ()
diamond.plot (diamond.edges (base, 1))
lines (diamond.edges (base, 4))
lines (diamond.triedges (base, 4))
title ("Triangles at Level 4", line=0)
```

---

diamonds

*Internal functions for diamonds package*

---

**Description**

Various functions for internal use in the diamonds package.

**Usage**

```
diamonds(b, d)
subdiamonds (b)
hexlines (b, d)
hiercenters (b, d)
subcenters (b)
hierlabels (parent, level, d)
deep (b, level, d)
labeldeep (dt, parent, level, d)
centerdeep (b, level, d)
randlevel (t1, level, d)
ranptdia (b)
```

**Arguments**

b	list of coordinates of vertices of a diamond
d	final depth of recursion of partition
level	current depth of recursion
parent	label of next higher level diamond
dt	list of labels being build recursively
t1	list of diamonds

**Details**

See R codes.

**Author(s)**

Denis White, <white.denis@epa.gov>

**See Also**

[diamond.base](#)

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