SECTION 10

Gravitation Deflector Engineering Design

From theory to practical engineering design

THE DEFLECTOR

The overall deflector consists of:

- A support having a verified perfectly horizontal upper surface for the cubic crystal deflector bottom face to rest upon;
- Monolithic Silicon cubic crystal ingots as follows:
    - *30 cm* in diameter,
    - *50 cm* or more thick,
    - with the orientation of the cubic structure marked for proper placement of tilt-generating shims, and
    - with the bottom face of the cylinder sawed and polished flat at a single cubic structure plane of atoms.

  [or equivalent tilt orienting / calibrating provisions]
- Precision shims *4.5 mm* thick for producing the tilt of the cubic crystal ingot, the shims located at the mid-point of two adjacent sides of the horizontal plane of the cubic structure as in Figure 10-1 below.
- Alternatively, a precision tilt-generating mechanism.
- For an array of ingots for a larger area than a single ingot can provide, the individual ingots can be machined to fit snugly together. That could be done by machining them to a square cross section or, better, to a hexagonal one.

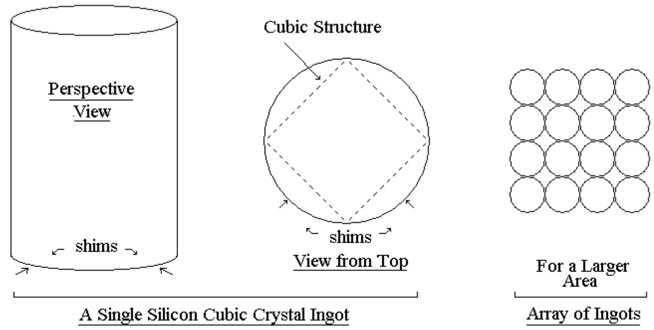

Figure 10-1 – The Silicon Cubic Crystals Arrangements

PRACTICAL ASPECTS IN DESIGN ENGINEERING

While the net Earth gravitational field is vertically upward, i.e. radially outward from the Earth's surface, local gravitation is radially outward from each particle of matter. As in Figure 10-2 below, a mass above the Earth's surface receives rays of gravitational attraction from all over the Earth's surrounding surface and from the underlying body of the Earth.

The net effect of all of the rays' horizontal components is their cancellation to zero. The net effect of all of the rays' vertical components is Earth-radially-outward vertically acting gravitation.

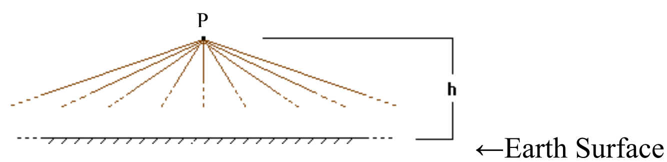

Figure 10-2 - Rays of Gravitation from the Surroundings

Gravitational Ray's Horizontal and Vertical Components.

One can consider all of the net gravitational effect on objects as being due to the vertical component of all of the myriad rays of gravitational field *Flow* at a wide variety of angles to the horizontal.

The various rays of the *Flow* propagation from the individual particles of the gravitating body [for example the Earth] are from each individual particle of it to the selected point [above the gravitating body] on which their action is being evaluated. That is the point P in the above Figure 10-2.

The Earth's gravitational action along a ray of *Flow* takes place from the Earth's surface to deep within the Earth. The inverse square effect, that the strength of a *Flow* source is reduced as the square of the increase in the radial distance of it from the object acted upon, is exactly offset by that the number of such sources acting [per "ray" so to speak] increases as the square [non-inverse] of that same radial distance. That is, the volume, hence the number, of *Flow* sources for a ray of propagation at the object is contained in a conical volume, symmetrically around the ray with its apex at the object acted upon.

However, because the net gravitational effect is produced only by the vertical component of each ray of *Flow* propagation, the effectiveness of each ray is proportional to the Cosine of the angle between that ray and the perfectly vertical as the angle θ in Figure 10-3 below.

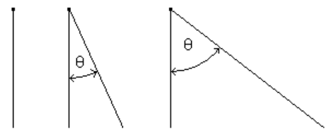

Figure 10-3 – The Gravitational Field Ray Angle to the Vertical

The actual total gravitational action includes all rays from $\theta = 0$ through to $\theta = 90º$. That would require an infinitely large deflector to act on all such rays, a disk of infinite radius. For lesser values of the maximum θ addressed, the portion of the total gravitation sources included is the integral of $Cos[\theta] \cdot d\theta$ from $\theta = 0$ *to* $\theta = Lesser\ Value$. The integral of the *cosine* is the *sine*. Example lesser portions of the total gravitational action addressed as θ varies are presented in Table 10-4 below.

θ	Sin [θ] = Fraction of Total Maximum Gravitational Action
0º	0.000
30º	0.500
45º	0.707
60º	0.866

Table 10-4

The gravitational deflector as a disk beneath the *Object* to be levitated must extend horizontally far enough to intercept and deflect the `Chosen Lesser Value` of angle θ rays of gravitational wave *Flow* that are able to act on the *Object* of the deflection as depicted in Figure 10-5 below.

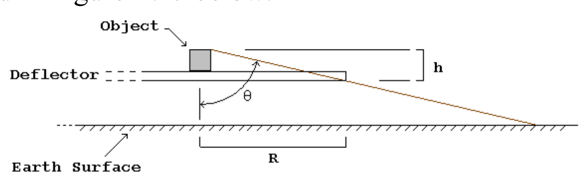

Figure 10-5 – Size Requirements for a Disk Shaped Deflector

For the perfectly vertically traveling rays of gravitation waves the required vertical distance that must be traveled within the cubic crystal is the previously presented at least $50\ cm$ and 0 horizontal distance is traversed in so doing. But a ray at angle θ, in order to traverse the required 50 cm vertically, must traverse horizontally $50 \cdot Tan[\theta]\ cm$, at the same time. For θ more than $45º$ that can become quite large and the deflector likewise.

Because the deflector disk must extend over a large area to deflect most of the gravitation, an alternative, and better, solution to the problem of rays of gravitation arriving over the range from $\theta = 0$ *to* $\theta = 90º$ is to wrap the deflector up the sides of the *Object* to be levitated as shown below.

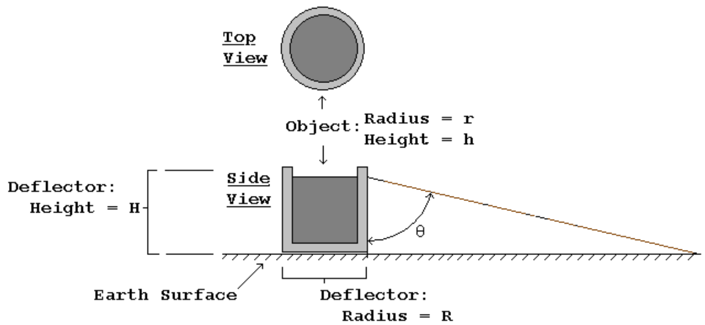

Figure 10-6 – More Efficient Cup-Shaped Deflector

In this configuration the deflector takes up little more space than the *Object* levitated. However, the non-perfectly vertical traveling rays must still travel within the cubic crystal the horizontal distance $50\cdot Tan[\theta]$ cm. That requires that the horizontal thickness of the vertical sides of the cup-shaped deflector must be of that $50\cdot Tan[\theta]$ cm thickness.

Because the value of $Sin[\theta]$ and, therefore, the fraction of the total gravitational action, increases relatively little above $\theta = 60º$ whereas the value of $Tan[\theta]$ increases quite rapidly, from 1.7 to ∞ above $\theta = 60º$ that $\theta = 60º$ is the appropriate value to which to design. The thickness of the "walls" of the "cup" would then be $50\cdot Tan[60º] = 85$ cm. The deflector would be only slightly larger than the *Object* levitated.

<u>Gravitation Deflector Design Parameters</u>

The Deflector is a cup shaped array of monolithic Silicon cubic crystals. The crystals forming the flat "base" of the "cup" must be 0.5 m in height. The "sides" of the "cup" will be the same kind of 0.5 m crystals stacked and aligned vertically. The thickness of the "sides" must be 0.85 m.

The crystals are grown with circular cross-section and in diameters up to 30 cm; however, those cylindrical pieces must then be machined to hexagonal or square cross section for a number of them to fit together with negligible open space. The cross-section area of these crystals is $\pi\cdot d^2/_4 = 0.785\cdot d^2$

For a circular deflector the configuration is poorly compatible with arranging the crystals in a close-fitting array unless it involves a large number of crystals each of small cross-section relative to the horizontal cross-section of the overall deflector. For that case the crystals should be machined to hexagonal cross-section. For smaller deflectors the configuration should be rectangular and the crystals machined to square cross-section.

Case	Preferred Crystal Cross-Section	Crystal Cross-Section Area	Percent Used of Original Crystal
Circular Deflector	Hexagonal	$[\sqrt{3}/_3]\cdot d^2 = 0.577\cdot d^2$	73.5
Rectangular Deflector	Square	$d^2/_2 = 0.500\cdot d^2$	63.7

Table 10-7

a. Circular Cross-section Gravitation Deflector Structure

A circular cross-section gravitation deflector structure to provide deflection for an object of height, h, and diameter, d meters would have the following parameters.

Base Disk: Thickness = t = 1 Crystal Layer = 0.5 m
Diameter = d + 2·[t = cup sides thickness]
Area = $\pi \cdot [d+2 \cdot t]^2/4 = 0.785 \cdot [d+1.7]^2$

Cup Sides:

Thickness t = 0.85 m
Outside diameter [OD] = d + 2·t = d + 1.7
Inside diameter [ID] = d
Height = h
Height Nr. of Layers = $h/0.5$
Area of Layer = $\pi \cdot [OD^2 - ID^2]/4$
= $0.785 \cdot [OD^2 - ID^2]$

Taking Silicon at $1.00\ \$/kg$ and its density at $2,329\ ^{kg}/_{m^3}$ the examples below obtain [MKS units and 1 m = 39.37″]. The $0.85\ m$ thickness of the "cup" "sides" requires 20 layers horizontally of $2″$ crystals.

d	h	Cup Disk Base		Cup Sides		Total Volume	Total Cost $	Nr. of 2" Hex Crystals
		Area	Volume	Area	Volume			
1	1	5.72	5.75	4.94	4.94	10.7	24,897	13,280
10	10	131	1310	29	290	319	742,951	779,570

Table 10-8

b. Square Cross-section Gravitation Deflection Structure

A square cross-section gravitation deflector structure to provide deflection for an object of square cross-section side, s, and height, h meters would have the following parameters.

Base Square: Thickness = t = 1 Crystal Layer = 0.5 m
Side = s + 2·[t = cup sides thickness]
Area = $[s + 2 \cdot t]^2 = [s + 1.7]^2$

Cup Sides:

Thickness t = 0.85 m
Outside square side OS = s + 2·t = s + 1.7
Inside square side IS = s
Height = h
Height number of Layers = $Height/0.5$
Area of Layer = $OS^2 - IS^2$

Taking Silicon at $1.00\ \$/kg$ and its density at $2,329\ ^{kg}/_{m^3}$ the examples below obtain [MKS units and 1 m = 39.37″]. The $0.85\ m$ thickness of the "cup" "sides" requires 3 layers horizontally of $12″$ crystals.

s	h	Cup Disk Base		Cup Sides		Total Volume	Total Cost $	Nr. of 12" Square Crystals
		Area	Volume	Area	Volume			
1	1	7.3	7.3	6.3	6.3	13.6	31,674	195
10	10	137	1370	36.9	369	1,739	4,050,131	2,486

Table 10-9

Calibrating the Individual Silicon Crystals

The individual crystals making up the deflector cannot be grown exactly identical to each other. In each the orientation of the long axis of the cubic crystal structure may vary minutely from each of the others. That is, it is not certain that each crystal's base is purely a single plane of atoms of the cubic structure and thus is exactly perpendicular to the long axis of the crystal.

To find the optimum tilt and orientation for a single crystal the tilt must be varied over the range of possibilities while the effect of gravitation from exactly below it is observed on a balance scale. But, most of the effect of gravitation on a single crystal is not from exactly below.

The solution to that problem is to conduct the optimization atop a structure that, relying on the inverse square effect, effectively isolates the crystal from most of the gravitation from surrounding sources except that exactly below it – a high pedestal having a cross section comparable to that of the crystal, Figure 10-10.

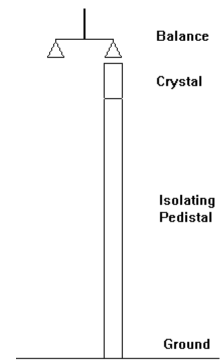

Figure 10-10

To conduct that calibration on thousands of crystals should not be necessary if a method can be developed to exactly measure the long axis orientation in any given crystal. The process can then determine the optimum orientation of the crystal tilt relative to the actual long axis of a few cubic crystals being calibrated. That same crystal tilt relative to the actual long axis can then be applied to each of the other crystals.

The long axis orientation problem could also be solved by a method of insuring that the base of each crystal is a single plane of atoms of the cubic structure.

Alternative to Calibration

Monolithic silicon cubic crystals are commercially available with the ends nearly a single plane, that is within 0.2 degrees of the (100) plane of the cubic structure. In view of the various effects analyzed in Appendix D, and their resolution in its section *The Random Distribution Solution to The Crystal Tilt*, that amount or moderately more of inaccuracy in the crystal tilt is of no significance except that it potentially may call for crystal thicknesses moderately greater than 0.5 m.

Before the design can further progress to definitive deflector structures and the control mechanisms for them two other actions that are beyond the scope of this work are required:

1. Experiments and testing to accurately establish the various overall design parameters: *e.g.* minimum required crystal dimensions and effectiveness of various tilts.
2. Specific design decisions are required for each of the various applications of gravitation control described in the next following Section 11: e.g. spaceship, planetary surface flying vehicle and power plant.