BSM Appendix 2-1

1. Node configuration of CL structure

Fig. [2.20] illustrates a geometry of a single node in position of geometrical equilibrium, and the axes of symmetry.

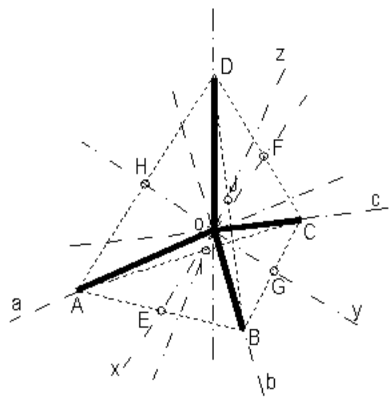

Fig. [2.20] CL node in geometrical equilibrium position The two sets of axes of symmetry are: *abcd* and *xyz*

The thicker lines designate the four prisms of the node, each one at angle of 109.5^o from the others. The ends ABCD forms a tetrahedron ABCD. The four axes, at which the prisms are aligned are **a, b, c, d,.** But the node has also another three axes of symmetry **x, y, z**, which passes through the middle of tetrahedron edges. This axes **x, y, z** are orthogonal each other. The **x,y,z** axes intercept the axes of **a,b,c,d** at angle of 54.75^o (half of 109.5^o)

2. Node displacement along anyone of abcd axes

The return forces acting on displacement in two opposite directions along anyone of abcd axes is not symmetrical. For this reason expressions for the return forces are derived separately for left and right displacement (denoted also as (-) and (+) displacements in respect to geometrical equilibrium point.

2.2 Displacement in negative direction (left side displacement)

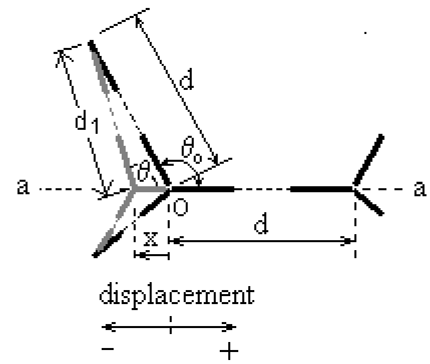

Fig. 1. Displacement along one of a,b,c axes. Displacement in minus x direction is shown (left side displacement) The black thick lines are prisms at equilibrium positions, the gray thick lines show the prisms at displaced position from

O - geometrical equilibrium point
$\theta_0 = 109.5^0$ - is an angle between prisms in point O
θ - is an angle between prisms at displaced position
d - is a node distance along anyone of abcd axes at equilibrium position
x - displacement from point O along anyone of abcd axes.
d_1 - is a changed node distance at displaced position

Using the law of cosines we get:

$$d_1^2 = d^2 + x^2 - 2dx\cos(\pi - \theta_0) = d^2 + x^2 + 2dx\cos\theta_0 \qquad (1)$$

$$d^2 = d_1^2 + x^2 - 2d_1 x\cos\theta \qquad (2)$$

Using Eqs (1) and (2) and solving for $\cos\theta$:

$$\cos\theta = \frac{d_1^2 + x^2 - d^2}{2d_1 x} = \frac{x + d\cos\theta}{\sqrt{d^2 + x^2 + 2dx\cos\theta}} \qquad (3)$$

The inverse cubic Intrinsic Gravitational force is

$$F = G_0\frac{m_0^2}{r^3} \qquad (4)$$

where: G_0 - an intrinsic Gravitational Constant between the nodes of different type. It is unknown but it will be eliminated in the final expression; m - intrinsic mass of the node, r - distance

For attracting IG force between the node and its right side neighbour is

$$F_R = \frac{G_0 m_0^2}{(d+x)^3} \qquad (5)$$

The resultant force from other three attracting forces from the other neighbouring nodes along the axes of *abcd* set pull in opposite direction. Anyone of these three forces acts upon an angle of $(\pi - \theta)$ in respect to the axis *a-a*. Therefore the three contributions are obtainable by multiplying the attractive forces by a cosine of $(\pi - \theta)$. Then the resultant force F_L from the three neighbouring nodes is expressed by:

$$F_L = 3G_0 \frac{m_0^2}{d_1^3}\cos(\pi - \theta) = -3G_0 m_0^2 \frac{\cos\theta}{d_1^3} \qquad (6)$$

The return force for displacement in (-) direction F(-) is a difference between F_R and F_L forces:

$$F(-) = F_R - F_L = G_0 m^2\left(\frac{1}{(d+x)^3} + 3\frac{\cos\theta}{d_1^3}\right) \qquad (7)$$

Substituting d_1 from Eqs (1) and $\cos\theta$ (given by Eqs (3)) in Eqs (7) and normalizing to the product $G_0 m^2$ we obtain an expression of the normalized return force acting on the node for displacement in (-) direction in respect to geometrical equilibrium.

$$F(-) = \frac{1}{(d+x)^3} + \frac{3(x + d\cos\theta_0)}{(d^2 + x^2 + 2dx\cos\theta_0)^2} \qquad (8)$$

Having in mind that the analysed displacement could be along anyone of axes abcd, the Eqs. (8) one and a same for anyone of these axes. Because the node distance parameter is unknown it is more convenient to normalize the deviation to d. In such case we may substitute $d = 1$ and considering that x is in fact x/d parameter. Then theoretically $x < 1$ but practically its upper limit is lower. Eqs. (8) simplifies to Eqs. (9) possessing only one argument.

$$F(-) = \frac{1}{(1+x)^3} + \frac{3(x + \cos\theta_0)}{(1 + x^2 + 2x\cos\theta_0)^2} \qquad (9)$$

2.3 Displacement in positive direction (right side displacement)

Fig. 2 shows displacement in right hand (+) direction along anyone of abcd axes.

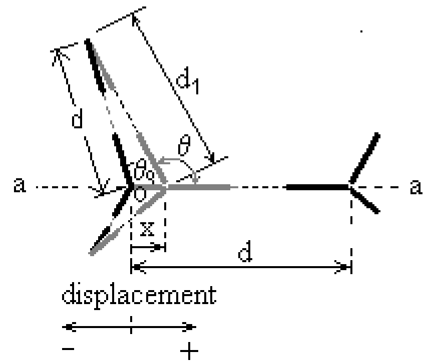

Fig. 2. Displacement in right hand (+) direction. The black thick lines show the prisms of the CL node at geometrical equilibrium. The thick grey lines shows the prisms of the CL node in deviated position

Using the law of cosines we get:

$$d_1^2 = d^2 + x^2 - 2dx\cos\theta_0 \qquad (10)$$

$$d^2 = d_1^2 + x^2 - 2d_1 x\cos(\pi - \theta) = d_1^2 + x^2 + 2d_1 x\cos\theta \qquad (11)$$

Solving Eqs. (9) and (10) for $\cos\theta$ we get

$$\cos\theta = \frac{d^2 - d_1^2 - x^2}{2d_1 x} = \frac{d\cos\theta - x}{\sqrt{d^2 + x^2 - 2dx\cos\theta}} \qquad (12)$$

The IG force pulling in right direction along axis *a* is

$$F_R = \frac{G_0 m_0^2}{(d-x)^3} \qquad (13)$$

The resultant force from the three attracting forces of other neighbouring nodes along the axes of *abcd* pulls in an opposite direction. Anyone of these three forces acts upon an angle of $(\pi - \theta)$ in respect to the axis *a-a*. Therefore the three contributions are obtainable by multiplying the attractive forces by a cosine of $(\pi - \theta)$. Then the resultant force F_L from the three neighbouring nodes is expressed by the same Eqs (6).

Substituting d_1 from Eqs. (10) and $\cos\theta$ from Eqs. (12) in Eqs (6) we obtain an expression of the return force acting on the node for displacement in (+) direction in respect to geometrical equilibrium.

$$F_L = G_0 m_0^2 \frac{3(x - d\cos\theta_0)}{(d^2 + x^2 - 2dx\cos\theta_0)^2} \qquad (14)$$

The return force for displacement in (+) direction F(+) is a difference between F_R and F_L forces. Dividing by the unknown factor $G_o m_0^2$ we obtain the normalized value of this force. Additionally substituting $d = 1$, we may consider x as normalized parameter on d. Then the return force for displacement in positive direction is:

$$F(+) = \frac{3(x - \cos\theta_0)}{(1 + x^2 - 2x\cos\theta_0)^2} - \frac{1}{(1-x)^3} \qquad (14)$$

2.4. Plotting the return forces for negative and positive displacement

Note: We must keep in mind that in both cases (positive and negative displacement) we considered x as a positive parameter theoretically restricted in a range $0 < x < 1$. (In a real case the deviations are in much smaller range (this is evident in the dynamic oscillation analysis of CL node in Chapter 2 and 4)). Therefore Eqs (8) and (14) are defined only for positive values of x.. Therefore when plotting the forces as function of x we must consider that:

- for the deviations in a positive direction x increases from left to right
- for deviations in a negative direction x increases from right to left.

Fig. [(2.23)] shows the plot of the return force in a relative scale along anyone of *abcd* axes in function of displacement x, normalized to the inter-node distance.

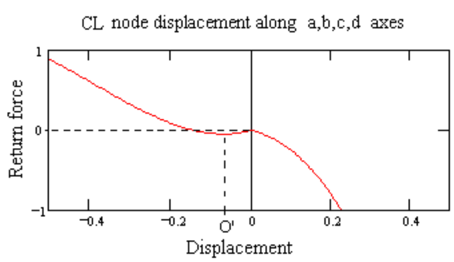

Fig. [2.23] Return force of normalized force in function of displacement normalised to the inter-node distance

Conclusion:

- **Under inverse cubic law of gravitation, the return force for a positive and negative deviation along anyone of *abcd* axes is dot symmetrical**

3. Node displacement along anyone of xyz axes.

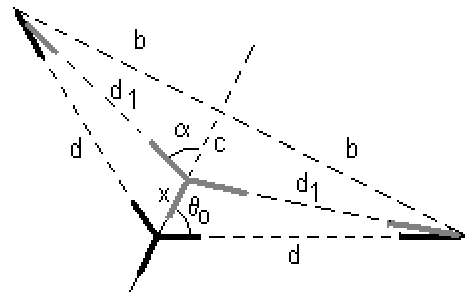

Fig. 3. Displacement of CL node along one of xyz axes (x axis is shown) The projections of the two prisms in the left down corner of the figure coincide. If the structure is rotated at 90 deg around the x axis the projection of the upper two prisms will coincide.

Following a similar approach and applying the Pitagor theorem and cosine laws leads to derivation of the expression along anyone of *xyz* axes.

[(2.14)]

$$F = 2\left[\frac{x + d\cos\left(\frac{\theta}{2}\right)}{\left[x^2 + d^2 + 2xd\cos\left(\frac{\theta}{2}\right)\right]^2} - \frac{d\sqrt{0.5(1+\cos(\theta))} - x}{\left[x^2 + d^2 - 2xd\cos\left(\frac{\theta}{2}\right)\right]^2}\right]$$

The plot of Eq. [(2.14)] for positive and negative displacement is shown in Fig [(2.21)].

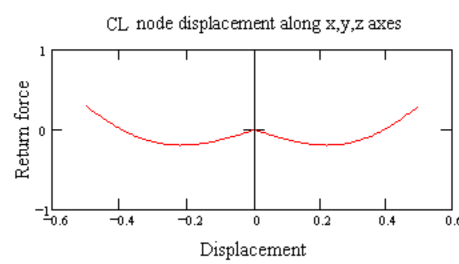

Fig. [2.21] Return force for displacement along x, y, z axes

The return forces plot is symmetrical and have two valleys along x,y,z axes, at both sides of the geometrical equilibrium point 0.

4. Complex oscillations due to different return forces along both sets of axes: abcd and xyz.

It is not difficult to imagine what kind of oscillations the CL node will have. The symmetrical return forces along xyz will contribute to a close to a planar type motion cycle with four bumps and four dimples. The asymmetrical return forces along abcd axes will cause continuous rotation of the cycle mentioned above until full close surface is circumscribed. This is further discussed in §2.9.2.

The complex oscillation could be regarded as consecutive displacements in any angle in 4π in which the displacement along abcd and xyz axes are only particular cases. If for one particular displacement we integrate the expression of the return force on displacement in a range from the lowest point to the point of geometrical equilibrium we will obtain expression of energy well valid for displacement along the chosen axis. Following this approach the total energy well could be estimated. as a average integral from all possible directions in 4π range.

Note: This type of oscillations provide AC type of Zero Point Energy of CL space that is related to Electrical and Magnetic fields. (AC is as alternative current in electrodynamics). The CL grid contains a DC type of energy well, that is much larger (DC is as direct current in electrodynamics). It could appear only if we imagine that we force to separate CL nodes. For analogy the surface waves of the ocean could be regarded as AC type energy, while the gravitation from the water column as DC type of energy.

