Appendix C (to Chapter 2)

CL node return forces and oscillations

Note: Figures and equations shown in Chapter 2 are shown here by the same number put in square bracket [...].

1. Node configuration of CL structure

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

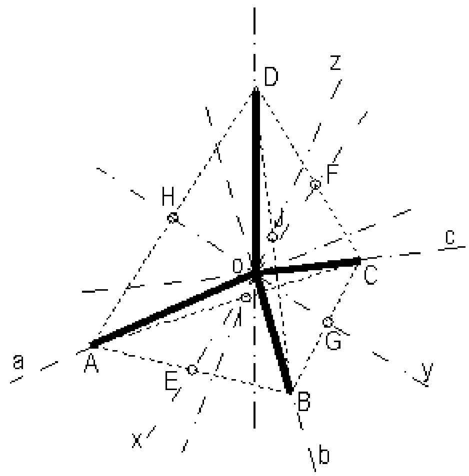

Fig. [2.20] CL node in geometrical equilibrium position The two sets of axes of symmetry are: *abcd* and *xyz*

The four prisms of the node are shown by thick lines. The point where they are connected (by attracting SG forces) is the CL node origin. The prisms are aligned along ***a, b, c, d*** axes intercepted at point O. The free ends ABCD of the prisms form a tetrahedron ABCD if the angle between each one of ***abcd*** axes is 109.5^{o}. This state of the CL node is called a geometrical equilibrium. Then *abcd* axes are regarded as axes of symmetry. However, the CL node has also another three axes of symmetry **x, y, z**, which passes through the middle of tetrahedron edges. This axes ***xyz*** are orthogonal each other. In a geometrical equilibrium the ***xyz*** axes intercept the axes of ***abcd*** at angle of 54.75^{o} (half of 109.5^{o}). In CL structure every single node is connected to 4 neighbouring nodes of another intrinsic matter, which prisms have opposite handedness. In geometrical equilibrium, both set of axes (abcd and xyz) between neighbouring nodes coincide. the abcd axes coincide even in non equilibrium position. In not geometrical equilibrium

2. Node displacement along anyone of *abcd* axes

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

2.2 Displacement in a negative direction (left side displacement)

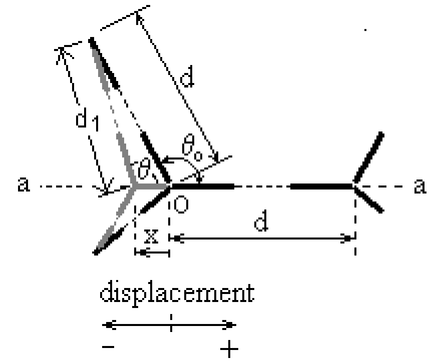

Fig. 1. Displacement along one of abcd axes. Displacement in minus x direction is shown as a left side displacement. The black thick lines are the position of the prisms prisms at geometrical equilibrium of the CL node, while the gray thick lines show the prisms at displaced positions

Notations:
O - geometrical equilibrium point
$\theta_0 = 109.5^0$ - angle between prisms in point O
θ - 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 - changed node distance at displaced position

Applying 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 Super 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, however, it will be eliminated in the final expression; m - intrinsic mass of the node, r - distance

The hypothetical origin of SG field is discussed in Chapter 12. It leads to the consideration that the sign of SG field between the opposite types of CL nodes in CL structure may change the sign. Let analyse the return forces only at attraction SG forces between neighbouring nodes (of opposite intrinsic matter). For attracting SG field, the 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:

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

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

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

Having in mind that the analysed displacement could be along anyone of axes *abcd*, the Eq. (8) appears to be valid 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 consider that *x* is in fact *x/d* parameter. Then theoretically $x < 1$ but practically its upper limit is lower. Eq.Eq. (8) simplifies to Eq. (9) possessing only one argument.

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

2.3 Displacement in positive direction (right side displacement)

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

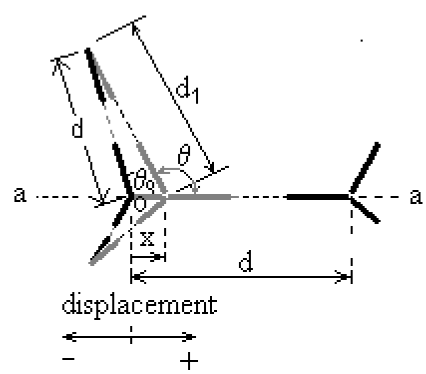

Fig. 2. Displacement in right hand (+) direction. The black thick lines show the prisms of the CL node at geometrical equilibrium. The thick grey lines shows the prisms of the CL node in displaced position

Applying 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 Eq. (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 SG 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 Eq. (10) and $\cos\alpha$ from Eq. (12) in Eq. (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 a 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 Eq. (8) and (14) are defined only for positive values of *x*. So, 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.

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

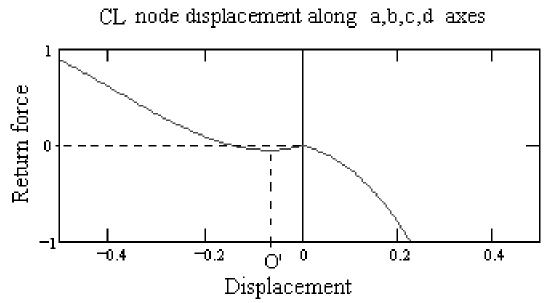

Fig. [2.23] Return force of normalized force in function of displacement normalised to the internode distance

Conclusion:

- **Under inverse cubic law of gravitation, the return force for a positive and negative deviation along anyone of *abcd* axes is not symmetrical**

3. Node displacement along anyone of *xyz* axes.

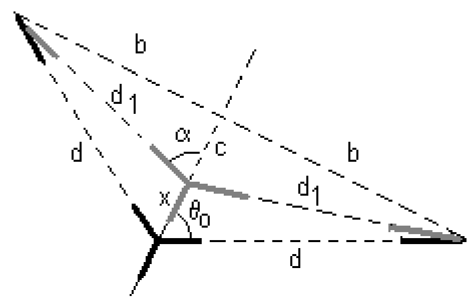

Fig. 3. Displacement of CL node along one of *xyz* axes (*x* axis is shown) The projections of the two prisms in the left down corner of the figure coincide. If the structure is rotated at 90 deg around the x axis the projection of the upper two prisms will coincide.

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

$$F = 2\left[\frac{x + d\cos\left(\frac{\theta}{2}\right)}{\left[x^2 + d^2 + 2xd\cos\left(\frac{\theta}{2}\right)\right]^2} - \frac{d\sqrt{0.5(1+\cos(\theta))} - x}{\left[x^2 + d^2 - 2xd\cos\left(\frac{\theta}{2}\right)\right]^2}\right] \qquad [(2.14)]$$

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

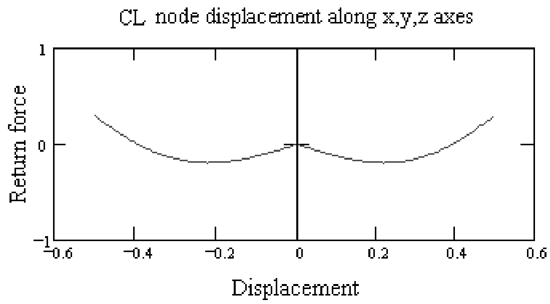

Fig. [2.21] Return force for displacement along anyone of xyz axes

The return forces plot is symmetrical and have two valleys along anyone of xyz axes, positioned symmetrically in respect to the point of geometrical equilibrium 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 trajectory of such cycle, however, will be not a closed, since the influence of the return forces along *abcd* axes, so we may call it a quasicycle. The asymmetrical return forces along *abcd* axes will cause continuous rotation of the quasicycle mentioned above until a closed trajectory is obtained. The multiple trajectories of the quasicycle will circumscribe a 3-D surface with 6 bumps, aligned with the xys axes and 4 dimples aligned with abcd axes. This is further discussed in Chapter 2, §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.