# Strain Energy for Central Force Field

Expand and enlarge the energy graph by changing the refraction at the hyper plane, for each ray, shown to the right for the 5th ray. This will increase the elastic modulus.

Though the size of the curve will increase, its general form will remain the same. So we use the curves already obtained for our analysis.

As applied to the universe and the big bang, we start with gas at the singularity, point #3 shown in orange, and work our way out in small particle or gas form (curve shown in color orange). This expansion will continue up to point 1 which is the 4° limit. At this point the big bang takes place expansion still continues while the space starts to cool and and we work our way down on the blue curve.

While working our way down the material curve shown of the expansion will still continue up to the 1 degree limit, as we are cooling down on the blue curve.

Physically, as material is forming during cooling, it (the space full of matter) is still being pulled by the tensile force of the expansion due to the explosion from the big bang.

At or before the singularity point say point 2, if nothing is done, the universe will continue in the blue path, the faith of which we will explain shortly.

If before singularity a second explosion is created, this will expand the space and help release the tensile forces acting much like a damper. This explosion could be man made and hence the reason we are here. To change the future and set the universe in its right path, the curve shown in black. It is very ironic that the creator would create the earth where its inhabitants would evolve to a point where they are able to change the future course of the universe at their own sacrifice, but that, however unfortunate, could be the case. If so, we should have by now built a spaceship capable of long distance travel through space, inhabited by various species of earth's living creatures. Kind of Noah's Arc if you will. This is what the Mayans believed to be the case and why their calendar ends at about this time, the year 2000 to 2014.

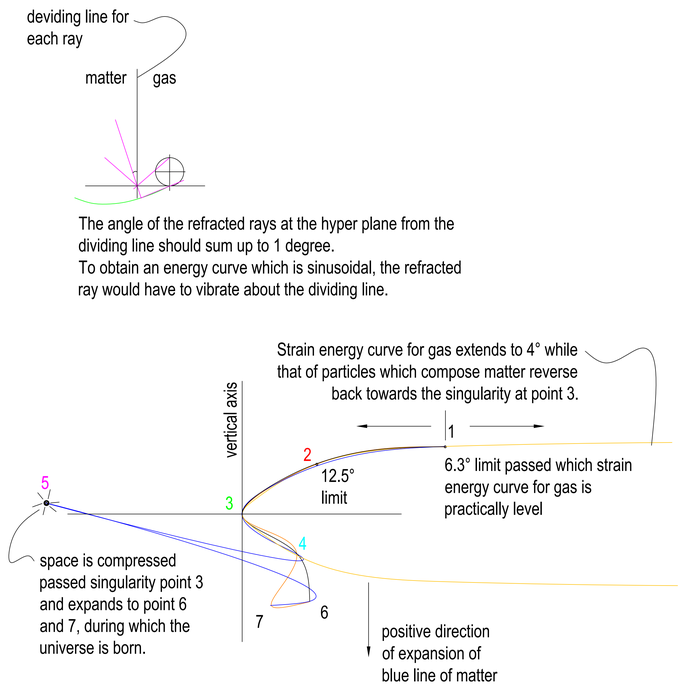



Figure -2: Superimposed strain energy diagram of materials

As mentioned before, if at or before the singularity point say point 2, nothing is done, the curve will continue in the blue path passed the singularity to the branch / bifurcation point at 4. At the branch point it will go through a sudden jump which will result in compression of the space down to and passed the singularity, where it will rebound once more to point 6 and 7. From point 5 on down to 6 and 7 is where the stars and planets are formed.

From point 5 on to 6 and 7, as more and more material starts to form, torsional rotation will decrease.

Let us take point 5 as the origin and rotate the curve by 90° clockwise. (Figure-3) This will be the strain energy curve with the starting point taken at point 5. Material will start to form from point 5 up to point 6,7.

Now coming back from point 5, imagine instead of material forming, we actually break the material. Then we have a fork in the diagram which provides us with the negative energy given off in the form of heat to the left of point 4, and positive energy due to strain to the right. This is the manner in which the positive and negative energy should be divided.

Now let us apply this diagram to column buckling. As we are loading the member in compression, reversing the diagram makes complete sense since compressive stresses are considered negative. Starting from point 1, as we apply compression to the member, we drop down to point 3 which is a point of stable equilibrium. We can still increase the load on the column up to point 4 without failure. When the column is loaded up to point 3, it will vibrate left to right when struck. Hence we know that there are bending stresses at work here.

Taking a closer look, the stress distribution across the cross section of the column is one of uniform compression from 1 up to point 2. At point 2, the entire cross sectional area of the member is stressed in compression. As we increase the load, bending rotational stresses start to develop. At point 3, full bending and compressive stresses act on the cross section. Passed point 3 but less than the bifurcation point 4, the pressure distribution is the mirror image of 2 to 3 above and below the neutral axis of the members cross section. Due to this bending effect, starting at point 2, shear forces will develop at the support up to point 3. The member will then vibrate back and forth up to the bifurcation point. The amplitude of vibration will be proportional to the strain on the horizontal axis. Passed the bifurcation point 4, the column will buckle and fail with increased loading, where we drop down to point 5.

Now this buckling failure can be gradual or sudden. When the column (compression member) is braced against shear, if the restraining members fail gradually, then on the curve we would continue from 4 to 6 or 7 and we would have progressive collapse. However, if the restraining members fail suddenly, then we would drop all the way down to point 5.

The members stressed condition is one of plain strain due to its form (meaning cross section and length). Hence it should be restrained against torsion. As most columns are not restrained against torsion along their length, then this condition is not one of plain strain and torsional effects should be considered in the design. The diagram of figure-3 does not incorporate the effects of torsional forces as the forces on a particle in a central firce field lie in a plane. A factor of safety against torsion would then be necessary when using this diagram for rigid body dynamics.

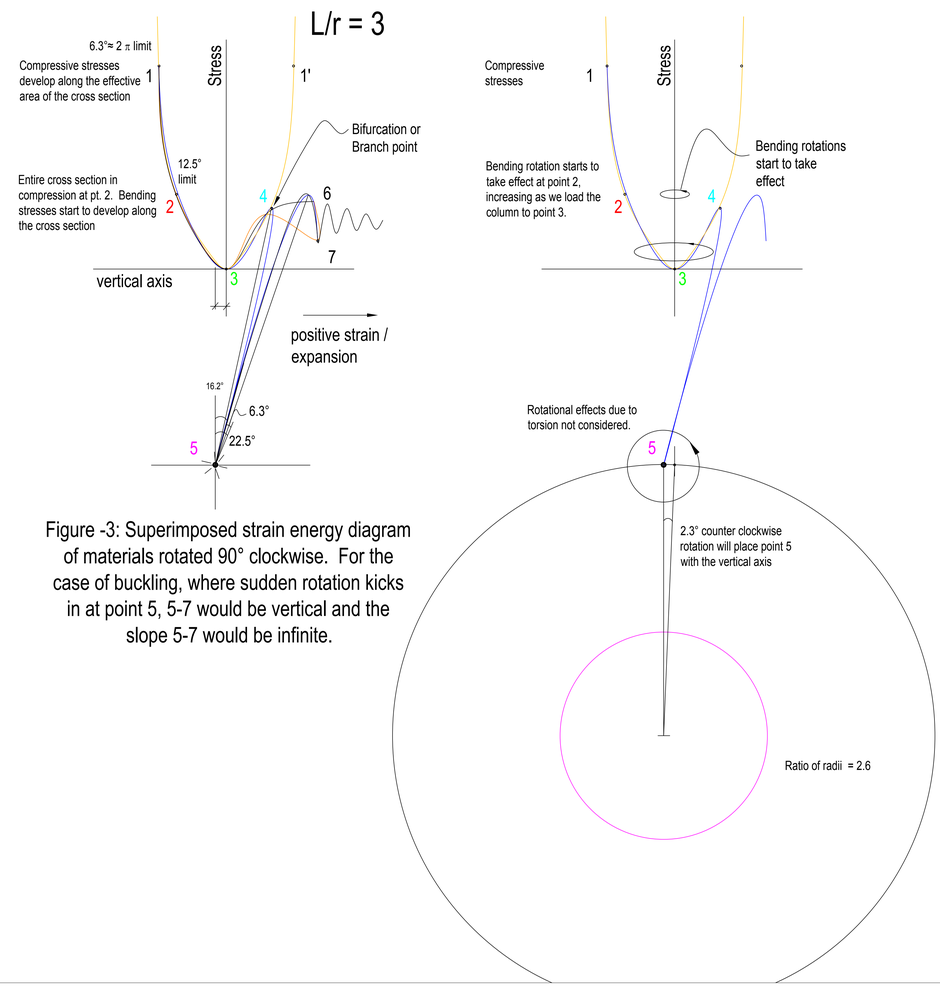



Figure -3: Superimposed strain energy diagram of materials rotated 90° clockwise. For the case of buckling, where sudden rotation kicks in at point 5, 5-7 would be vertical and the slope 5-7 would be infinite.

# Strain Energy and Column buckling

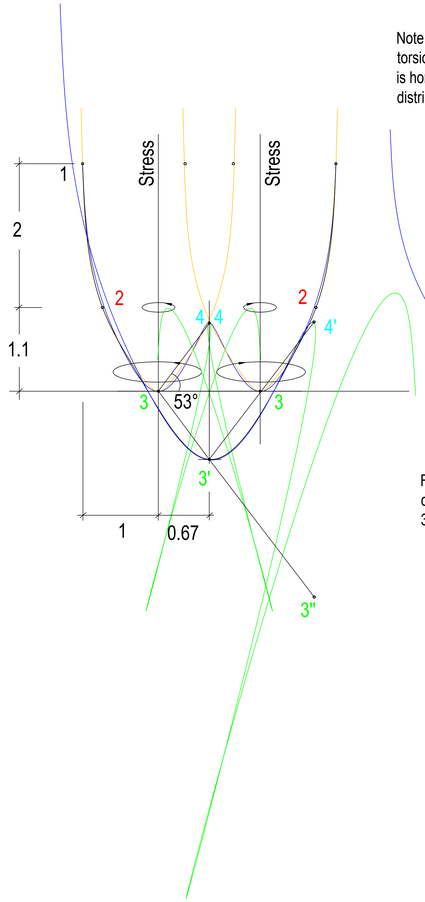



Figure -5: Energy diagram for a diatomic molecule joined at the bifurcation point. New singularity at 3'.

Note: Since member 3-3 is turned 90 degrees and becomes horizontal, the bending and torsional rotations reverse. This is also the case at point 3 when the tangent to the curve is horizontal. If the member 3-3 is inclined, the bending and torsional spin will be distributed proportional to the angle of inclination.

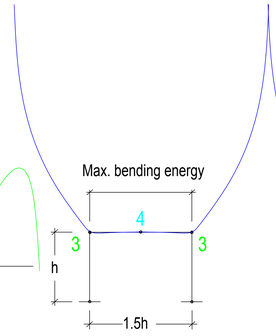



Fig. 6: Frame assembly with two columns and a beam. Beam member 3-3 resisting the energy in bending.

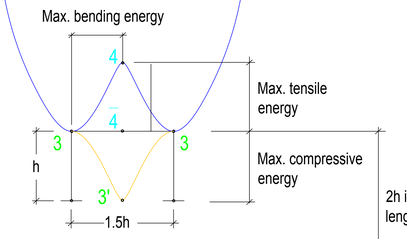
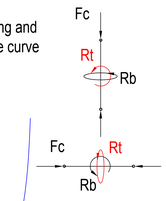
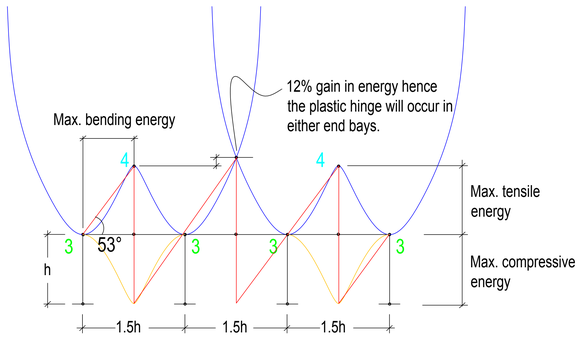



Fig. 7: Frame assembly. Beam 3-3 resisting the energy in combined compression and bending.

2h is the maximum column length in figure 6




3 Bay Frame Assembly. Beam at the interior bay gains strength in tension and compression by 12%.
A saw tooth wave is obtained for the energy diagram of the frame with bifurcation point at point 4. The angle of the wave is at 53°. If the angle is higher than 53°, the frame is deemed unstable and its stability increases with lowering the angle.

The ratio of compression to bending energy is 2 to 1. The ratio of 1-2 to 4-$\bar{4}$ is 2 to 1, hence if all the members have the same cross sectional properties, the single bay frame with span to height ratio of 1.5 can withstand a lateral load up to one half the vertical load carrying capacity of a single column.

When the column is joined to another member, point 3 becomes the bifurcation point at the connection joint.

Note, if the member is a horizontal beam, as opposed to a vertical column, then the rotation of bending and torsion reverse. We can build a tree or map by continuing in the vertical and horizontal direction. Then the if we connect any to points, the inclination will provide the ratio between the two spins.

For the assembly as a whole, point 4' becomes the new bifurcation point.

If 3' was to move up on the diagram to point 4, the two members will separate at point 4, and the assembly will fail.

Plane 3-4-3 vibrates about the horizontal line. Below the line, the connection stability is increased and above the line the joint is unstable.

If line 3-3 on the energy diagram remains horizontal, then the joint will be in bending.

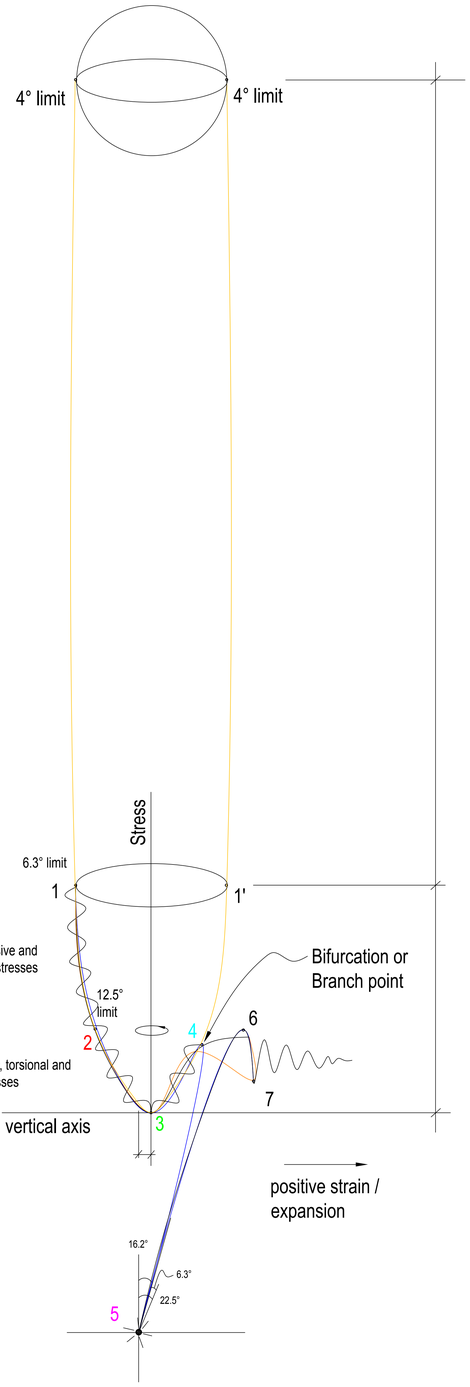



Figure -4: Engergy diagram for member in compression with torsional rotation effects

4.5 X (amount of gas / dust)
Multiply by 1.25 to take into account the spin.

X (matter in the form of stars and planets) L/r = 3

If the compression column is a column of soil with voids filled with water, then as water tries to leave the pores the column will vibrate and we obtain a sinusoildal energy curve from point 1 to 4 on the strain energy diagram. This is due to torsional rotation. As we approach point 3, where the tangent to the curve is horizontal, the torsional and bending rotations interchange.

Similarly, as we load the member in tension, and the member elongates, energy which tries to bend and torque the column when loaded in compression, will leave the specimen loaded in tension while rearranging the member's crystal structure and the column will vibrate.

# Spatial Relation of Particles in a Central Force Field

D = 20 Dc if the spin of the particle is taken into account

4.75° limit

Reverse in curvature will compress and decrease the distance between polar opposite singularities by a factor of 1.6128

4° limit

r

4.75° limit

4.5 X (amount of uncompressed gas / dust)

L/r = 13.5

L

Stress

6.3° limit

1 1'

Bending rotations start to take effect at point 2, 12.5° limit

2 4 6

3 7

X (matter in the form of stars and planets accumulate in the trough)

L/r = 3

Roughly the same amount of solid material which does not enter the trough, will then orbit around the core

5 2.3° rotation will align point 5 with the vertical

Dust / Gaseous Matter entering singularity at point 3.

4.75° limit

L/r = 8.5

Core Radius Rc at bifurcation point = 0.71 Rc entering trough

4° limit

Pseudospheres in plan at bifurcation point 4

1.8 X (amount of compressed gas / dust)

Stress

6.3° limit

1 1'

Bending rotations start to take effect at point 2, 12.5° limit

2 4 6

3 7

X (matter in the form of stars and planets accumulate in the trough)

Roughly the same amount of solid material which does not enter the trough, will then orbit around the core

5 2.3° rotation will align point 5 with the vertical

As matter/pressure builds up inside the trough, since it can not get out at the singularity, the surface will crack and break at point 4.

Factors above must be increased by 1.25 to take into account particle rotation

4° limit

Compress

4° limit

Compress

6.3° limit

L/r = 8.5

Rotational effects due to torsion if considered, will pull all the gaseous material towards the center forming the core. The solid material given off will rotate around the core.

4.75° limit

Core Radius Rc

Region 1-2 compression Radius R1-2 = 5.25 Rc

Dust/gaseous material will move into the trough and get pulled towards the core

R5 = 10.76 Rc

Region 2-3 compression and bending shape could be eliptical R2-3 = 8 Rc

Stress

6.3° limit

1 1'

Bending rotations start to take effect

2 4 6

3 7

Solid material which does not enter the trough, will then orbit around the core. There is no information lost!

At 3 Bending and torsional effects interchange

Matter entering singularity

R4° = 15.64 Rc

5 2.3° rotation will align point 5 with the vertical

Compress

4° limit

Compress

4° limit

Space for 4° to $7^{1}$° limit

R 4°limit ≈ 16 Rc . If spin of the particle is taken into account, then the radius will increase by 1.25 to 20Rc. See direct acting engine mechanism.