Mechanical behavior of materials

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Week-

Lecture-33

Dislocation Dissociation & Dislocation Line Tension

Namaskar phir se swagat karta hoon aapka is course mein Mechanical Behavior of Material jo hum Hindi mein padhenge. Last part mein humne energy dekhi thi Screw Dislocation aur Edge Dislocation dono pure nature ke the. Is part mein hum dekhenge ki Mixed Dislocation jo hai uski energy kis tarah se nikalenge aur usi se connected kuch cheezein hum dekhenge jaise Dislocation Dissociation aur Dislocation Line Tension. Iske baare mein bhi aaj hum padhenge.

To pehle dekhte hain ki Energy of a Mixed Dislocation kya hai. To jab hum energy of mixed dislocation nikalenge to hum kya karte hain ek simple superposition rule apply karte hain edge aur screw parts ka jo energy hai unko hum elastic energy hai elastic energy per unit length of dislocation jo hai pure edge aur pure screw parts ki wo superimpose kar dete hain. To maan lete hain meri dislocation line hai is tarah se to iska ek line vector bhi nikal dete yahan pe is tarah se mera line vector hai aur agar mera dislocation mixed hai to humein pata hai ki ye jo dislocation hai kuch Burgers vector jo hai kuch angle banayega is dislocation ke saath. Maan lete hain kuch is tarah se ek angle bana raha hai ye mera Burgers vector hai isko main b se denote kar raha hoon yahan par aur ek kuch angle bana raha hai ye angle main mark kar raha hoon yahan par ek ϕ angle bana raha hai ye. To aap dekhenge ki ye Burgers vector hai kuch angle bana raha hai ek yeh zero bhi nahi hai 90 bhi nahi hai to yeh mixed dislocation hai mera.

To hum kya kar sakte jab iski energy nikalenge tab hum is dislocation ko decompose kar sakte is tarah se ya ek horizontal component nikal sakte aur agar main horizontal yahan par ek component yahan par is tarah se nikalun to yeh yeh angle ϕ hai to yeh jo component ho jayega yeh mera $b\sin\phi$ ho jayega aur yeh jo component hai ye yeh is tarah se vertical component yahan par dikha raha hoon main agar ye angle ϕ hai to yeh ho jayega $b\cos\phi$. To aap yeh dekh pa rahe honge abhi to yeh jo do components hai ye mere kyunki mera Burgers vector hai to is vector ke main do components nikal sakta hoon kuch is tarah se. To aap dekh payenge ye jo do components hai ye component hai ye parallel hai mere tangent vector ke saath. Agar ye parallel hai to yeh jo component ho jayega isko main yahan pe naam de raha hoon b_s yeh mera screw component ho jayega yani screw part ho jayega is dislocation ka aur yeh jo component hai yeh perpendicular hai is tangent vector ke saath to yeh jo part ho jayega ye mera part ho jayega edge part isko main naam de raha hoon b_e.

To main kuch agar yeh superposition principle istemaal kar raha hoon to main mere paas yeh do edge aur screw components hai uska energy main likh sakta hoon kuch is tarah se. To main elastic energy per unit length is tarah se likh sakta hoon Gb_e^2. Yahan par aap dekhenge ki yahan par maine edge component istemaal kiya yeh Burgers vector ka aur yeh relation humein mila tha pure edge ke liye. To yahan par jo component hai sirf yahan pe b ki jagah maine b_e istemaal kiya aur yahan pe jo component hai Burgers vector ka wo maine screw component istemaal kiya hai. Yeh jo mera relation tha ye mere pure screw ke liye tha. To main in dono ko add kar raha hoon isko hum superposition principle kahenge to main dono ki elastic energy hai wo sirf add kar raha hoon yahan pe yani superimpose kar raha hoon.

To agar main b_e ki jagah $b\sin\phi$ likhta hoon ya b_s ki jagah $b\cos\phi$ likhta hoon mere paas kuch aise relation aa jayega aur main isko simplify karta hoon to aap dekhenge ki meri paas ek elastic energy per unit length aayegi jisko main is Burgers vector ke saath likh sakta hoon:

$$E = \frac{Gb^2(1 - \nu\cos^2\phi)}{4\pi(1 - \nu)} \ln\left(\frac{R}{r_0}\right)$$

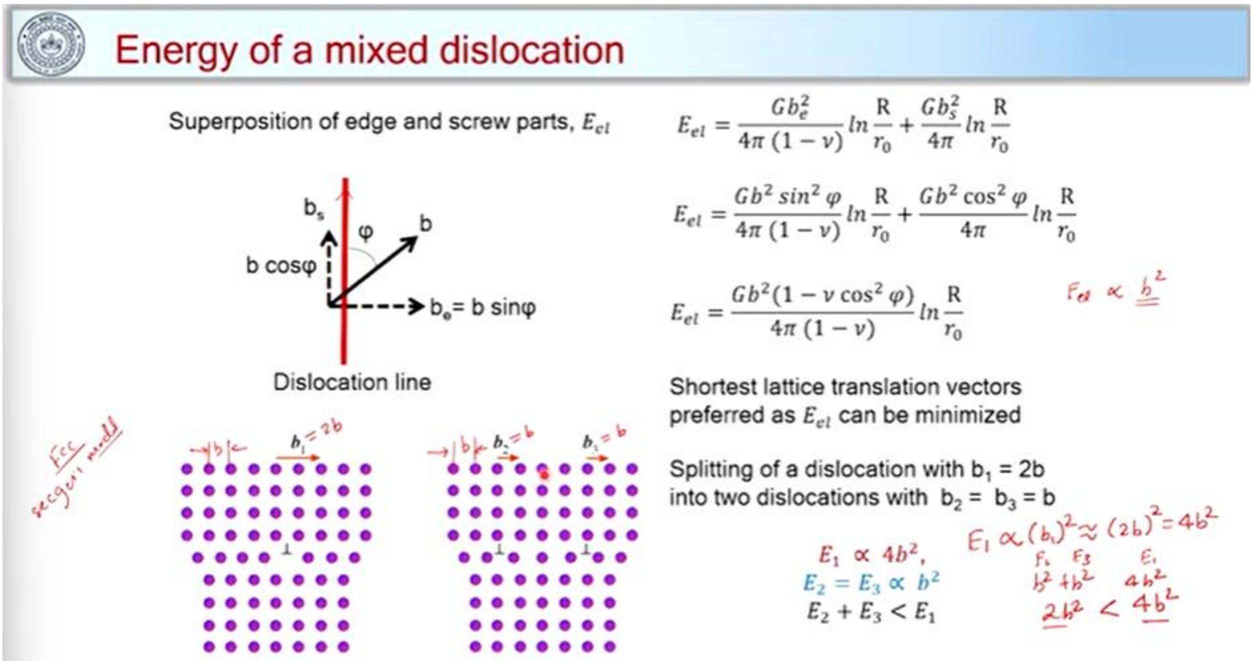
To yeh jo ϕ hai yeh angle bana raha hai mere tangent vector ke saath yeh jo Burgers vector angle bana raha hai tangent vector ke saath. To aap dekh payenge agar yeh angle shunya hai to yeh jo energy ho jayegi yeh ho jayegi mere Screw Dislocation ke barabar. Agar yeh angle 90 hai to yeh ho jayegi energy ye jo relation ho jayega ye completely ho jayega mera Edge Dislocation ke barabar. To yeh ho gayi meri Elastic Energy per Unit Length for Mixed Dislocation yani Dislocation Mixed Dislocation ke liye. To aap yahan par bhi dekhenge jo mixed dislocation hai yahan par bhi jo energy hai ye directly proportional hai b^2 se yani magnitude of Burgers vector ka jo square hai uske directly proportional hai yeh jo elastic energy ye humein yaad rakhna hai yahan par.

To yahan par bhi hum dekhenge ki agar yeh Elastic Energy main likh leta hoon yahan par Elastic Energy hai Dislocation ki per unit length hai theek hai. To yeh proportional hai meri b^2. To ab dekhenge ki yeh jo energy agar minimize karni mere Dislocation ki to b ki value kam honi chahiye. To isliye lattice hamesha Short Lattice Translation Vector prefer karega elastic energy ko minimize karne ke ye hum is relation se samajh sakte hain.

Abhi kuch interesting dislocations hum dekhte hain jaise kuch is tarah se. To yahan par aap dekhenge ki maine do extra half plane yahan par rakhe hue aur yeh mera edge nature yahan par maine dikhaya iska magnitude hai b. To yeh jo extra half plane hai yeh b_1 hai. To yeh jo type ke dislocations hai yeh humein FCC structures mein aap Seeger ke model dekhenge to main yahan pe likh leta hoon ye FCC structures mein humein milte hain especially hum Seeger agar dekhenge to humein kuch do extra half planes kuch is tarah se mark kiye hue dikhenge.

To abhi ke liye jante hain ye mera Burgers vector hai aur aap dekhenge ki yeh Burgers vector yahan pe do Burgers vector mein divide ho raha hai ya dissociate ho raha hai. To aap dekhenge ki yahan pe ek extra half plane hai aur yahan pe ek extra half plane hai. Maan lete hain yahan par yeh jo magnitude hai isko likh lete hain yeh jo magnitude hai isko main maan raha hoon b aur yeh jo spacing hai yeh jo distance hai isko bhi main b maan raha hoon. To aap samajh payenge ki b_1 jo hai b_1 ko main likh sakta hoon kuch is tarah se b_1 ko main $2b$ likh sakta hoon b_2 aur b_3 ko main likh sakta hoon b ke barabar. To main yeh keh sakta hoon ki jab ye b_1 split hoga split hoga yani tootega ah to b_2 aur b_3 milenge mujhe. To yeh $2b$ jab tootenge tab mujhe b aur b is tarah se dislocation mujhe split hoke milenge.

To agar main jab is configuration ki baat karunga to energy kya rahegi? To energy main likh paunga Energy proportional to b_1^2. To is case mein kya hoga aap dekhenge ki energy jo hai pehle meri dislocation ki yeh proportional to b_1^2 hogi to main likh sakta hoon isko b_1 ko $2b$ ki tarah to yeh ho jayegi meri $4b^2$. To hamare paas $4b^2$ aayega pehle configuration ka energy. Agar main dusre configuration ki energy dekhunga to yahan pe is part ki energy agar main dekhunga to aap dekhenge ki yeh E_2 aur E_3 proportional rahegi $b_1 b^2$. To main in dono ko agar add kar raha hoon E_2 aur E_3 yani b_2 ke corresponding energy aur b_3 ke corresponding energy agar main dekh raha hoon to main likh paunga yeh $2b^2$ ke directly proportional hai agar main in dono ko add karunga to mere paas kuch is tarah se aayega $b^2 + b^2$ ye E_2 hai aur yeh E_3 hai aur E_1^2 agar main dekhunga to yeh $4b^2$ hai. To aap dekhenge ki mere paas $2b^2$ hai aur jo smaller hai mere $4b^2$ se. To aap dekhenge ki is tarah se yeh jo b_1 hai woh dissociate hoga kyunki yahan par energy kam ho rahi hai dislocation ki isliye ye dissociate hoga b_2 aur b_3 mein. Hum isko aur acche se padhenge hamare course mein par yahan ke liye hum yeh soch sakte hain ki yeh jo dislocation hai yeh split ho sakta hai split ho sakta hai nahi toot sakta hai do dislocation mein b_2 aur b_3 ke.



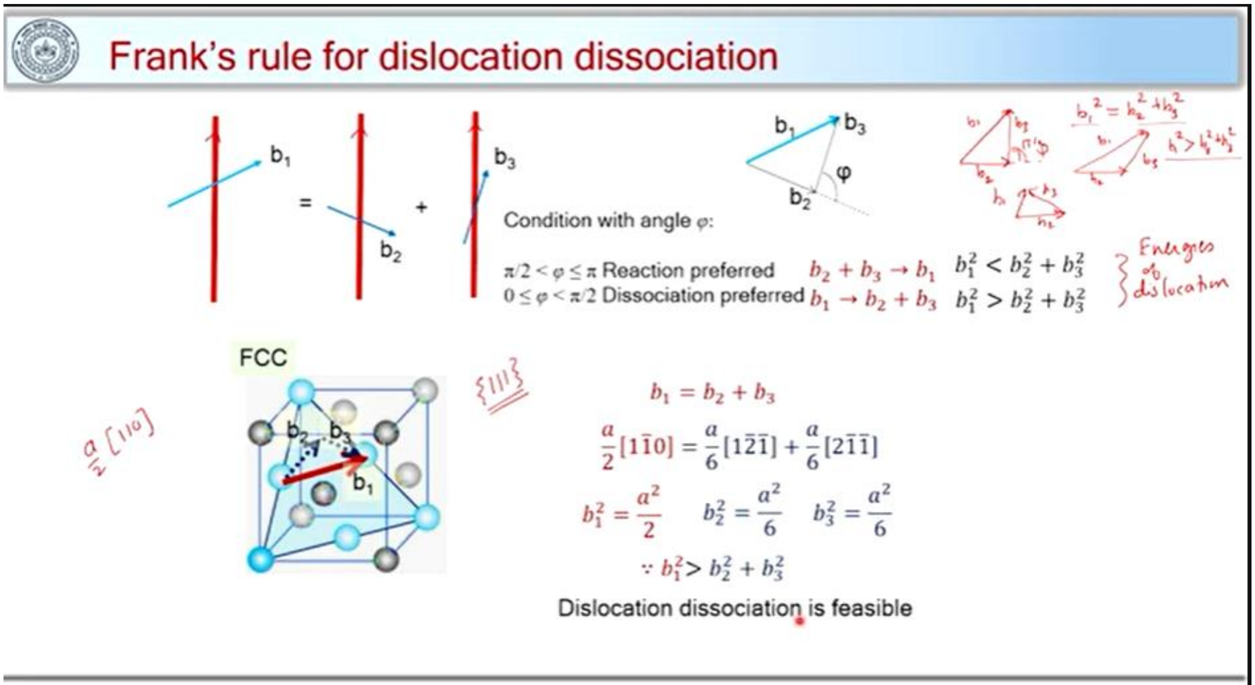
To hum ek Dislocation Dissociation ke rules dekhte hain Frank's ke. To isko kehte hain Frank's Rule for Dislocation Dissociation. To maan lete mere paas ek Tangent Vector hai mera ek dislocation hai aur ek uska ek Burgers vector hai b_1. To main kuch is tarah se likh sakta hoon isko yeh jab dissociate hoga tab yeh Tangent Vector uske same rahenge ek hi direction mein rahenge yahan par jo Tangent Vector hai kuch is tarah se rahenge but yeh jo Dislocation hai jab dissociate hoga to b_2 b_3 mein dissociate ho raha hai. To yeh kab dissociate hoga ya yeh bhi ho sakta hai ki yeh dono combine hoke join hoke ek ek dislocation banaye. To yeh criteria abhi hum yahan par padhenge. To mere paas b_1 hai aur yeh b_2 hai aur b_3 hai is tarah se agar main inka vector addition dekhu to main kuch is tarah se likh paunga aur maan leta hoon ki ek included angle hai b_2 aur b_3 ka angle jo hai woh ϕ hai yahan par yeh angle ϕ main maan raha hoon. To kuch rules hai Frank's ke is tarah se.

To ab dekhenge ki agar yeh jo included angle hai iske value par dislocation ek to dissociate hoga nahi to react honge kuch is tarah se dekhte hain. To pehle ye yeh consider karte hain yeh criteria ki dislocation jo ϕ ki value hai 0 $\pi/2$ ke beech mein hai to tab mera Dislocation Dissociation prefer hoga aur jab ϕ ki value $\pi/2$ se badi hai aur π se kam hai to tab mera Reaction preferred hoga tab hum Dissociation ki baat karenge. To hum dekhenge ki agar yeh hum is tarah se kuch samajh sakte jaise maan lete mere paas $\pi/2$ angle hai yeh included angle jo hai yeh $\pi/2$ hai to yeh b_2 hai yeh b_3 hai to b_1 ki value kuch is tarah se aayegi. To main Pythagoras theorem agar simple Pythagoras theorem apply karunga to $b_1^2 = b_2^2 + b_3^2$ main likh sakta hoon. To is condition mein ye satisfied hogi. Par agar hum kuch is tarah se dekhenge agar $\pi/2$ se chhoti hai value ye value agar chhoti hai ye ϕ tha mera angle ye chhoti ho jayegi tab aap dekhenge mere paas kuch dislocation ke configuration kuch is tarah se aayenge ye mera b_2 tha b_3 tha aur ye b_1 hai to aap dekhenge ki b_1^2 ye aapko bada milega $b_2^2 + b_3^2$ se. Agar ye bada mil raha hai to ye b_1 prefer karega mere b_2 aur b_3 mein dissociate ho yani split ho jaye. To ye condition hai to yahan par main jaan pa raha hoon ki b_1^2 bada hai b_2^2 aur b_3^2 ke dono ke addition se.

Ab Reaction mein kya hoga Reaction mein aap dekhenge ki agar ϕ bada hai angle $\pi/2$ se to hamare paas kuch configuration is tarah se aayega is tarah se kuch configuration aayega yeh mera b_2 hai yeh mera b_3 hai aur yeh mera b_1 hai to kya hoga b_2 aur b_3 react karke b_1 ko form karenge to b_2 aur b_3 combine ho gaye aur mujhe b_1 milega yeh kab hoga jab mera b_1^2 smaller rahega $b_2^2 + b_3^2$ se. To aap dekh pa rahe honge yahan pe ye geometrically bhi aap dekh pa rahe honge ki ye configuration kis tarah se kaam kar raha hai. To ye depend karega ki mera included angle kya mere Burgers vectors ka jo Burgers vector dissociate ho rahe. Yeh hamara Frank Rule hai. Frank Rule mujhe ek Energy Criteria deta hai yeh mera hai Energy Criteria. Yeh b^2, $b_2^2 + b_3^2$ yeh darsha rahe Energy dikha rahe hain mere Dislocation ki. To yeh ek Energy Criteria hai isko hum Frank's Criteria kehte hain.

Abhi dekhte ki FCC ke case mein humne ek baar baat ki thi jab FCC ke case mein ki ek jo dislocation hai perfect dislocation hai wo dissociate hota hai. To humne baat ki thi ye jo mera dislocation hai yani yeh $a/2\langle 110\rangle$ type dislocation hota hai hamesha ye Shortest Lattice Translation Vector hai yeh humne dekha tha yeh is type ka hamara dislocation hota hai. To agar yeh jab dissociate hoga ye Perfect Dislocation hota hai ye split hoga do Partials mein FCC ke case mein. To yahan par yahan ke liye aap maan lijiye ye jo do Partials hai main kuch is tarah se likh paunga ye b_1 ho gaya mera yeh b_2 ho gaya aur yeh b_3 ho gaya. To main $b_1 = b_2 + b_3$ is tarah se likh pa raha hoon. To maine kaha tha ki yeh b_1 dissociate hoga b_2 aur b_3 mein. To yeh b_1 jo hota hai hamesha is type ka hota hai $a/2[1\bar{1}0]$. To ye dislocation mera dissociate ho raha hai kisme $a/6[1\bar{2}1] + a/6[2\bar{1}\bar{1}]$ mein. To yeh jo do dislocations hai inko hum Partials kehte hain. To humne yeh bhi dekha tha ki ye Partials kyun kehte hain kyunki yahan par koi Lattice Position nahi hai.

Abhi dekhte hain inki energy calculate karte hain pehle iski energy calculate karte hain. To aap dekhenge ki iski energy aayegi yahan pe b_1^2 agar main nikalun to iski energy aayegi $a^2/2$. Iski agar energy nikalenge ye b_2^2 to ye aa jayega $a^2/6$ aur iski agar energy nikalenge to ye aa jayegi $a^2/6$. Agar main in dono ko add karunga abhi yahan pe to aapko milega yahan pe aap dekhenge ki yeh jo do add karne ke baad mere paas aa jayega ye aa jayega $a^2/3$ aayega. To $a^2/3$ smaller hai $a^2/2$ se. To aap dekh pa rahe honge yahan pe ki jo b_1^2 hai wo bada hai $b_2^2 + b_3^2$ se. To yahan pe hum dekh sakte hain ki ye jo b_1 hai wo dissociate hoga in in b_1 b_2 aur b_3 mein. b_2 aur b_3 kya hai yahan pe mere Partial Dislocations hai. To main keh sakta hoon ki FCC mein ye dissociate ho sakta hai Perfect Dislocation in dono Partials mein. Yahan pe aap dekh pa rahe honge ki ye jo dissociation ho raha hai wo ek hi plane pe ho raha hai. To yahan pe bhi ek baat hamesha yaad rakhni hai ye ek plane pe ho raha hai ye $\{111\}$ type ke plane pe ho raha hai. Hum isko aur acche se dekhenge future mein par yahan par hum Frank's Rule samajhne ke liye yeh ek example humne yahan par liya tha. To yahan par main keh sakta hoon ki Dislocation of Dissociation is Feasible.



To abhi hum aage badhte hain. To yeh jo Energy Criteria hai isse hum ek aur concept yahan par samajhte hain woh hai Line Tension of a Dislocation Line. To Line Tension kya hoti hai? Line Tension ke liye aapko isliye is tarah se samajhna hoga ki Line Tension jo hoti hai wo Energy ke equivalent hoti hai. To agar mere paas ek Dislocation hai main ek Dislocation yahan par mark kiya hoon maan lete hain ki ye Dislocation yahan par pinned hai yani yahan se yeh move nahi ho sakta beech mein ye move ho sakta hai. Agar maine stress apply kiya koi bhi Shear Stress apply kiya to is Shear Stress ki wajah se ye Dislocation is tarah se move hoga kyunki yahan par pinned hai to ye move nahi ho payega par is tarah se move hoga. Jaise hi main Shear Stress release karunga chhod dunga to ye to yeh Dislocation wapas aane ki koshish karega yeh is tarah se agar yahan par koi Shear Stress nahi hai to yeh yahan par wapas aayega Dislocation straight hoga. To yeh jo straightening of dislocation hai yani jo dislocation ki tendency hai yahan par straight hone ki usko hi hum kehte hain Line Tension. Ye Line Tension ki wajah se Dislocation mera straight hone ki koshish karega. Ah ye kyun karega aap is tarah se samajh sakte hain kyunki jab yahan pe mera dislocation hai to ek uski ek Elastic Energy hai. Humne baat ki thi Elastic Energy jo hai wo per Unit Length hai yeh aapko yaad rakhna hai ki hum jab Elastic Energy ki baat karenge to Elastic Energy per Unit Length baat kar rahe hain.

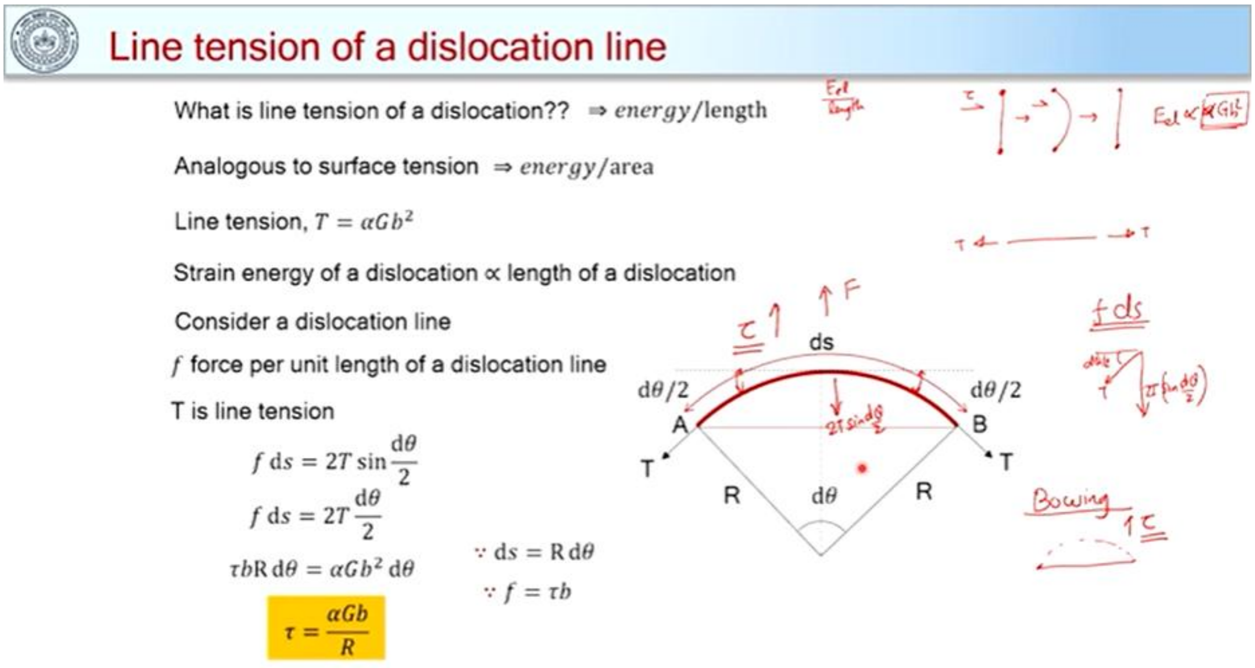
To agar jaise hi is yahan pe is configuration mein iski length kam hai to energy jo hogi yahan pe is configuration mein wo kam hogi. Jaise maine stress apply kiya to is stress ki wajah se yahan par is dislocation ko to nature lena pad raha hai par yahan par uski length bhi badh rahi hai ye curvature ki wajah se uski length badhegi. To yeh jo is configuration mein hai wo mere dislocation ki energy yahan par badh rahi hai. To jaise maine stress relieve kar diya chhod diya tab aap dekhenge ki dislocation ki length initial ho gayi ya kam ho gayi shorten ho gayi hai. To yeh yahan pe dislocation chahega ki apni energy per unit length kam rakhe to isliye usko ek tendency aa jati hai aur us tendency ko hi hum kehte hain Line Tension. Aap isko is tarah se bhi samajh sakte hain ki yeh Surface Tension ki tarah hai. Aapne Surface Tension padha hoga hamare paas Surface Energy hoti hai aur ek Surface Tension hota hai. To yeh jo Line Tension hai yahan par yeh Energy ke equivalent hai. Aur humne dekha tha ki Energy kya hoti ye Energy per Unit Length directly proportional to

$\alpha G b^2$ yeh humne dekha tha yahan par $\alpha G b^2$ ke barabar hoti hai. To aap dekhenge ki ye jo Tension hai wo bhi equivalent hai mere $\alpha G b^2$ ke. To iska iska agar hum dekhenge Surface Tension ka kya unit hota hai Energy per Area. Yahan pe bhi hum dekhenge ki Line Tension ka hum unit dekhenge Energy per Length wo nothing but yani wo just hamari Elastic Energy ki tendency hai Elastic Energy per Unit Length ki tarah hi hai. To jo magnitude hai wo same hai yahan pe par jo tendency hai usko hum Line Tension kehte hain.

Abhi hum isko aur achi tarah se samajhte hain. To yahan par maine ek example diya tha ki yeh curve ho raha hai yeh curve kis stress mein hoga yeh hum janenge yahan par. To Line Tension ko bhi main is tarah se likh sakta hoon $T = \alpha G b^2$ aur jab main yeh likhunga to main ye is tarah se keh sakta hoon ki Strain Energy mere dislocation ki wo directly proportional hai mere Length of Dislocation. To consider a dislocation line maan lete Dislocation Line hai mere paas A aur B yahan par main bol raha hoon ki A aur B mere pinned point hai yani yahan par Dislocation move nahi ho sakta yahan par pin kiye hue hai. To jab main stress apply karunga to Dislocation kuch is tarah se curvature lega ye abhi dekha hai humne. Maan lete is curvature length ko dS maan lete yeh small segments ki baat kar raha hoon main Dislocation Line Segment ki yani bahut small length segment ki baat kar raha hoon. To ek small curve aa gaya mere dislocation mein isko main dS naam diya aur jab ye curvature aaya to usko main define kar sakta hoon ki radius se aur us us radius ko main measure karta hoon R se agar ye R hai meri Radius Curvature ki to abhi main ek dekh paunga ek theta bhi yahan par subtend hoga kyunki ek arc hai yahan par to isko main maan leta hoon $d\theta$ ye $d\theta$ bhi bahut small hai chhota theta hai to iski magnitude bahut kam hai.

To jab yeh hoga aur main kuch is tarah se is point pe aap dekh payenge agar main ek tangent draw karta hoon to yeh jo angle hoga yahan pe yeh jo angle hoga yeh hoga mera $d\theta/2$ aur $d\theta/2$ to yeh dono angle mere $d\theta/2$ honge. Abhi aap dekh payenge ki yeh to geometry se main likh pa raha hoon to maan lete hain ki Force per Unit Length of a Dislocation ye meri F F darshata hai Force per Unit Length of a Dislocation. To agar yahan par ek Force lag raha hai F aur T agar Line Tension hai to Line Tension is tarah se mark kiye jayenge jab tension ki baat honge tab T is tarah se mark honge yahan par hum dekhenge T aur T is tarah se mark kiya hai agar hum koi cable consider karte hain to agar cable tension mein hai to hum tension is tarah se mark karte hain hamesha. To usi tarah se Line Tension maine mark ki hai T T is tarah se is Dislocation ko Dislocation par act hogi aur uske wajah se Dislocation hamesha straight hone ki tendency rakhega.

To jab yeh mera curvature aaya hai yeh curvature ek external force ki wajah se aaya isko jo humne ek force apply kiya uski wajah se aaya. To ab hum ek force balance likhenge. Force balance kis tarah se likh sakta hoon ki agar Force per Unit Length of Dislocation F hai to yeh Force yani humne dekha tha ki Force per Unit Length of Dislocation F hai to isko main dS se multiply karunga to mujhe Force milega jo is direction mein mera lagna chahiye ye F is direction mein lagna chahiye. To iski magnitude kya hogi $F \cdot dS$. Abhi isko balance karega mera Tension Line Tension jo hai wo balance karega isko. To yahan par hum kam force balance karenge yahan par aap dekhenge ki yeh agar main dekh pa raha hoon yahan par yeh $d\theta/2$ hai to mujhe yeh component nikalna hai T ka to yeh T ka component aayega $\sin(d\theta/2)$ is tarah se aayega aur yahan par hum dekhenge ki tension is idhar bhi lag raha hai to yeh multiply ho jayega 2 se to yahan par mujhe 2 aayega mere paas 2 aayega to main $2T\sin(d\theta/2)$ ye downward direction mein lagega is tarah se idhar mark kar lete isko $2T\sin(d\theta/2)$. Abhi humne dekha ki ye $d\theta$ bahut small hai to main is $\sin(d\theta/2)$ ko $d\theta/2$ likh raha hoon directly. To aap dekh pa rahe honge ki mere paas kuch ek is tarah se identity aa gayi hai. Abhi ye T ki value mein $\alpha G b^2$ agar yahan par replace karta hoon to aap dekhenge yani yahan par maine $d\theta$ is tarah se likh sakta hoon main $d\theta$ ko bhi likh sakta hoon dS/R yahan par dS aur ye R hai ye $d\theta$ hai to $d\theta = dS/R$ likh sakta hoon to $F \cdot dS = 2T \cdot d\theta/2$ yahan pe main likh sakta hoon αGb^2 ye 2 aur 2 cancel ho jayega to mere paas $d\theta$ rahega. Abhi hum dekhenge ki ye dS jo hai dS aur $d\theta$ jo hai wo dS/R hai to main $F \cdot dS = T \cdot dS/R$ likh sakta hoon. To dS positive hai to dS cancel ho jayega aur $F = T/R$. To Force per Unit Length is equal to T/R. F ki value kya thi humne dekha tha $F = \tau b$. Force per Unit Length is τb. To main $\tau b = T/R$ likh sakta hoon ya main T ki value αGb^2 yahan pe replace karunga to mere paas kuch is tarah se equation aayega $\tau = \alpha Gb/R$. To main kuch is tarah se τ ki value nikal sakta hoon ye τ jo hai ye jo hai shear stress mujhe apply karna padega yeh curvature lane ke liye. Curvature kaun sa jiska radius R hona chahiye to is shear stress ki value mein is tarah se likh sakta hoon $\alpha Gb/R$.



To yahan pe humne ek concept dekha tha is is equation ki bhi hum baat karenge baad mein jab hamara Dislocation ke baare mein hum bowing ki baat karenge Dislocation Bowing ki baat karenge aage chalke tab hum dekhenge ki yahan pe Dislocation bow ho raha hai do point ke beech mein humne dekha tha ki Dislocation yahan pe aise bow ho raha hai kab wo ho raha hai jab main ek shear stress apply kar raha hoon τ aur ye τ ki value main is tarah se find out kar sakta hoon agar mujhe zyada bow karna hai to mujhe yani R ki value ghategi yahan pe to shear stress ki value badhegi. To aap dekhenge ki yeh jo value hai mujhe bata rahi hai ki ek shear stress kitna apply hona chahiye jab main mujhe Dislocation ko ek curve curve nature dena hai ya usko bow karna hai.

To yahan par ek concept humne samjhi thi Line Tension is slide mein Line Tension ki concept yahan par di thi jo magnitude mein Elastic Energy per Unit Length ke barabar hai aur ye Line Tension ek tendency hai Dislocation ki jo Dislocation ko straight karne ki koshish karegi jab uske upar koi external stresses act nahi ho rahe. To abhi ke liye main yahan par rukta hoon next part se hum janenge ki Dislocation aur Dislocation Interactions kya hote hain. To is part mein humne dekha tha ki Dislocation Dissociation hota hai Dissociation kyun hota hai kyunki wahan par hum Frank’s Rule apply karte hain jo ki Energy Rules hai aur yahan par humne dekha tha ek Line

Tension jo ki tendency hai Dislocation ki jo Dislocation ko straight karne ki koshish karenge. To abhi ke liye rukta hoon dhanyavad.