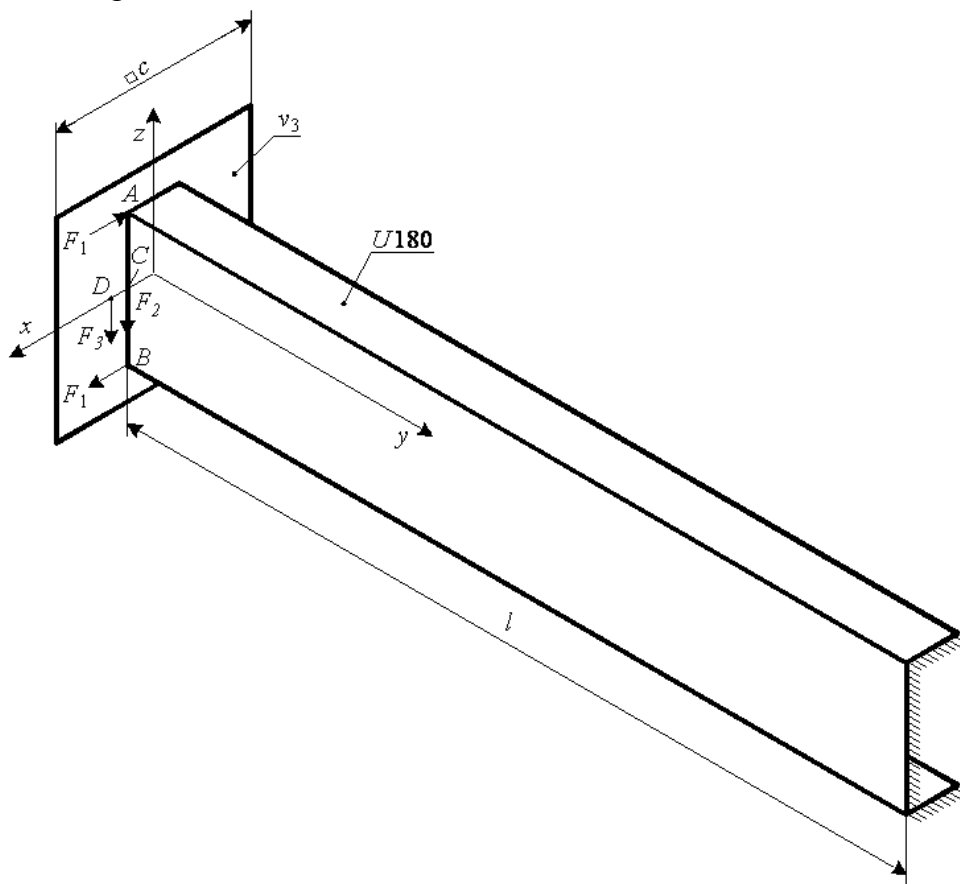


## Véges elem módszer 6. gyakorlat U gerenda

**Feladat:** U-gerenda modellezése lemezszerkezetként

### Adott

Egy U180-as profilból készült gerenda az egyik végén befalazott, a másik végére egy 10 mm vastag,  $250 \times 250 \text{ mm}^2$ -es négyzet alakú lemez van felerősítve, mely a terhelés felvételére és továbbítására szolgál.



### Terhelés

A gerendán 3 különböző terhelési esetet definiálunk:

1. terhelési eset: Csavarás erőpárral (gátolt csavarás a  $250 \times 250 \text{ mm}^2$ -es lap miatt)  
A és B pontban  $F_1 = 5000 \text{ N}$
2. terhelési eset: Hajlítás és csavarás a gerinclemez felezőpontjában működő erővel  
C pontban  $F_2 = 5000 \text{ N}$
3. terhelési eset: „Tiszta” hajlítás a csavarási középpontban ható erővel  
D pontban  $F_3 = 5000 \text{ N}$

### Anyagjellemzők

Az acél anyagjellemzői:

$$E = 2,1 \cdot 10^5 \text{ MPa}$$

$$\nu = 0,3$$

### A tartó geometriai méretei

$$a = 180 \text{ mm}$$

$$b = 70 \text{ mm}$$

$$\alpha = 3^\circ$$

$$c = 250 \text{ mm}$$

$$v_1 = 8 \text{ mm}$$

$$v_2 = 11 \text{ mm}$$

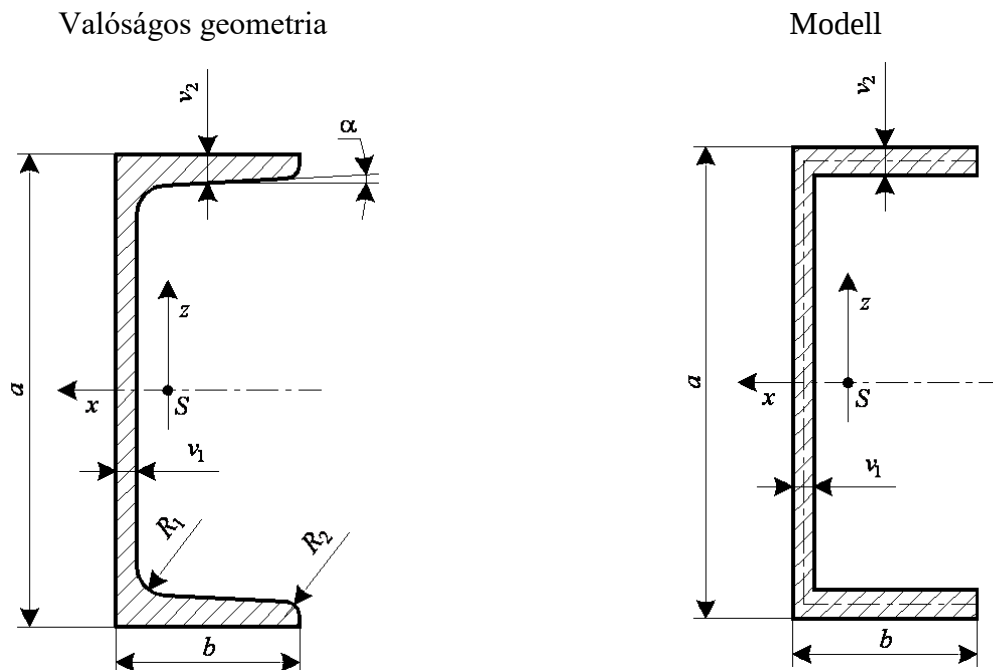
$$l = 1000 \text{ mm}$$

$$v_3 = 10 \text{ mm}$$

$$R_1 = 11 \text{ mm}$$

$$R_2 = 5,5 \text{ mm}$$

Az U-gerenda keresztmetszetét láthatjuk a következő 2 ábrán. Baloldalon a valóságos geometria van, a modellezéshez egy egyszerűsített geometriát használunk.



### Feladat mindegyik terhelési esetről:

- A középfelület deformált alakjának kirajzolása, a csomóponti elmozdulás értékek leolvasása.
- Redukált feszültségek ( $\sigma_{red}$ ) szemléltetése a külső és a belső felületeken, valamint a középfelületen szintvonalas ábrákon.
- A rúdírányú normál feszültségek ( $\sigma_y$ ) a középfelületen szintvonalas ábrákon.

A **hég** olyan test, melynek egyik mérete a másik két mérethez képest kicsi. A legkisebb méret a vastagság. Értelmezhető középfelület, amely görbült felület is lehet.

A Kirchhoff-Love-héjelmélet nem veszi figyelembe a nyírási alakváltozást. A hipotézis szerint hajlításkor a középfelület normálisai az alakváltozás után is normálisai lesznek az alakváltozott középfelületnek és a normálisokon lévő pontok távolsága nem változik.

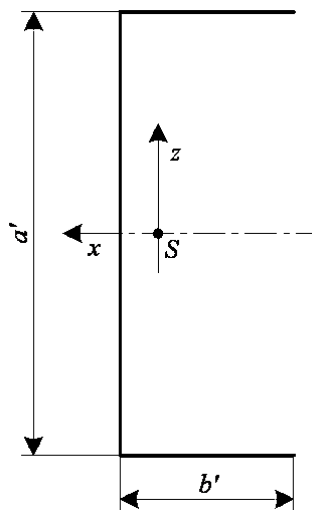
Ha a hég középfelülete párhuzamos az  $xy$  síkkal – ez az U-gerenda alsó és felső lapja –, akkor a geometriai hipotézis szerint  $\gamma_{xz} = \gamma_{yz} = 0$  és  $\varepsilon_z = 0$ . Az alakváltozási állapot:

$$[\underline{\underline{A}}] = \begin{bmatrix} \varepsilon_x & \frac{1}{2}\gamma_{xy} & 0 \\ \frac{1}{2}\gamma_{yx} & \varepsilon_y & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

A feszültségi hipotézis szerint  $\sigma_z \approx 0$ . A feszültségi állapot az alsó és felső lapon:

$$[\underline{\underline{F}}] = \begin{bmatrix} \sigma_x & \tau_{xy} & 0 \\ \tau_{yx} & \sigma_y & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

A számítások elvégzéséhez a tartónak, mint héjszerkezetnek csak a középfelületét rajzoljuk meg. A lemez modellhez szükségünk lesz a középvonalak geometriájára. A középfelületi méreteket mutatja a következő ábra.

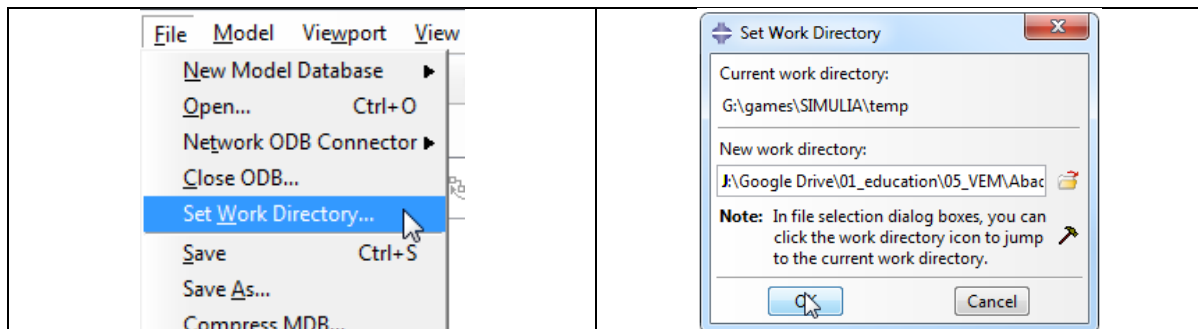


Középfelületi méretek:

$$a' = a - 2 \cdot \frac{v_2}{2} = a - v_2 = 180 - 11 = 169 \text{ mm}$$

$$b' = b - \frac{v_1}{2} = 70 - \frac{8}{2} = 66 \text{ mm}$$

Indítsuk el az Abaqus CAE programot. Adjuk meg a munkakönyvtárat a **File ► Set Work Directory...** paranccsal. A megjelenő ablakban a New work directory alá írjuk/másoljuk be a munkakönyvtárunk helyét, vagy válasszuk ki a A select... ikonnal. Ezután OK-zuk le az ablakot.

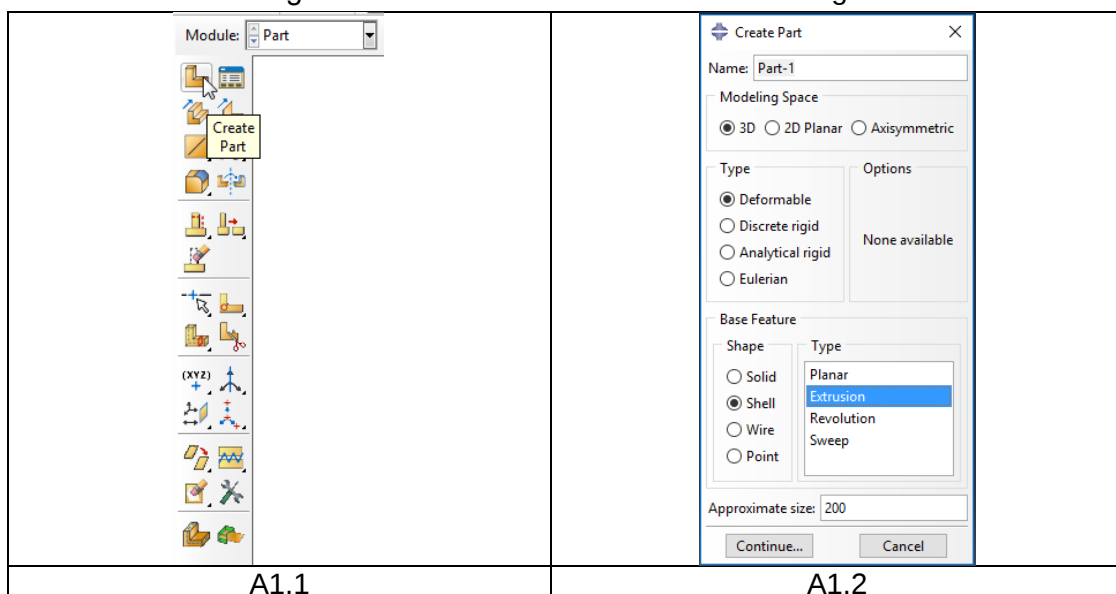


## A MODULE | PART geometria megrajzolása

A program megnyitása után alapértelmezésként a Part Modulban vagyunk. Ez a Modul szolgál a geometria létrehozására. Ehhez az alábbi lépéseket kövessük:

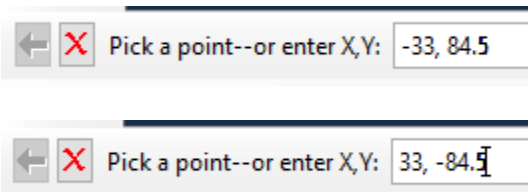
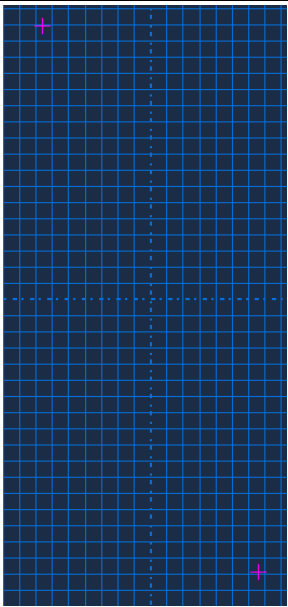
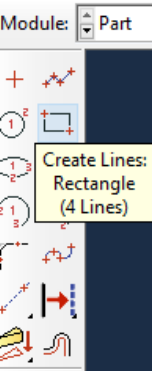
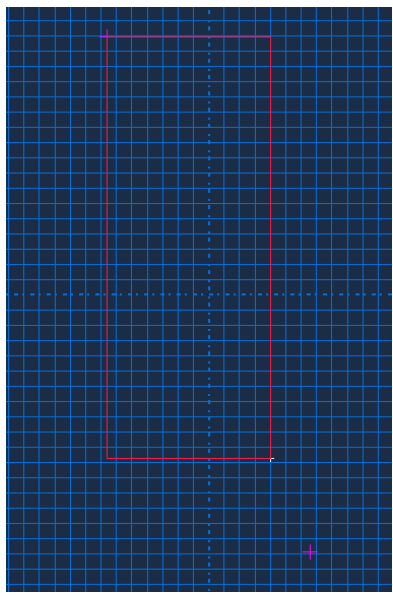
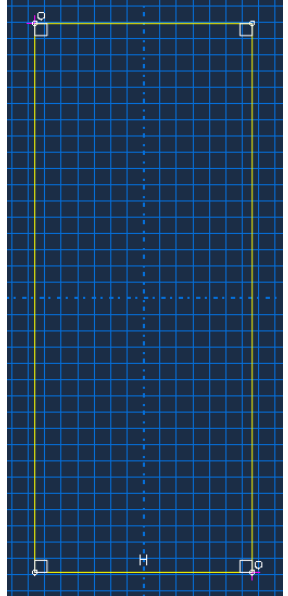
1. Az eszköztárból kattintsunk a **Create Part** ikonra. Az ennek hatására megjelenő Create Part ablakban az alábbi beállításokat végezzük el:
  - A Name után írjuk be az alkatrészünk nevét.
  - A Modeling Space alatt válasszuk ki, hogy síkbeli, azaz **3D** geometriát szeretnénk rajzolni.
  - A Type alatt hagyjuk az alapértelmezett kijelölést a **Deformable** előtt, mivel alakváltozásra képes geometriát szeretnénk.
  - A Base Feature alatt válasszuk a **Shell**-t. A Type-nál pedig az **Extrusion** opciót.
  - Az Approximate size-ot, tehát a modellünk méretét itt is beállíthatnánk, de erre majd később visszatérünk a segédrács beállításánál, most hagyjuk az alapértelmezett 200-on.

A fenti beállítások elvégzése után kattintsunk lent a **Continue...** gombra.



2. Az U gerenda geometriájának megrajzolásához:

- Válasszuk először az eszköztárból a **Create Isolated Point** parancsot, majd adjuk meg két sarokpont koordinátáit alul a beviteli mezőben. Tehát írjunk be **-33, 84.5** –öt majd középső gombbal fogadjuk el, ezután írunk be **33, -84.5** –öt majd szintén fogadjuk el középső gombbal. Ezután a grafikus ablakon megjelent a két pont.
- Ezután a **Create Lines: Rectangle** paranccsal rajzoljunk egy téglalapot, aminek egy átlón lévő két ellentétes sarokpontja az előbb megadott két pont.
- A **Delete** paranccsal töröljük ki a téglalap jobb oldalát, hogy megkapjuk az U profilt.
- Végül a beviteli mezőben kattintsunk a Sketch the section for the shell extrusion melletti **Done** gombra és a felugró Edit Base Extrusion ablakban a Depth sorba írjuk be a kihúzás értékét, vagyis **1000** -et.

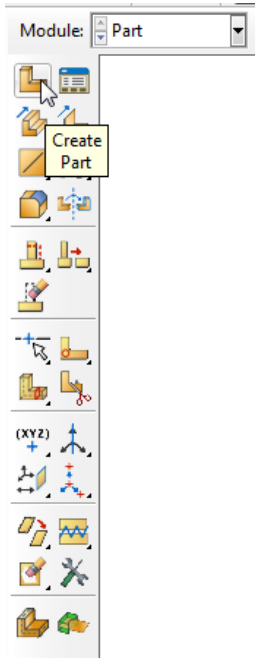
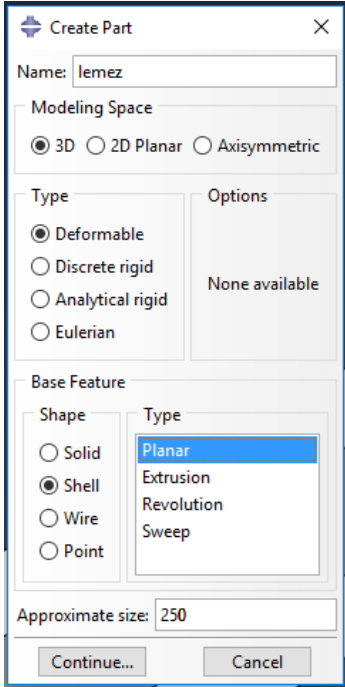
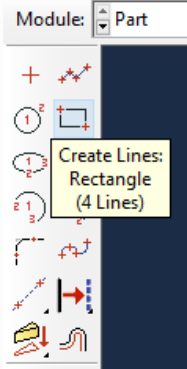
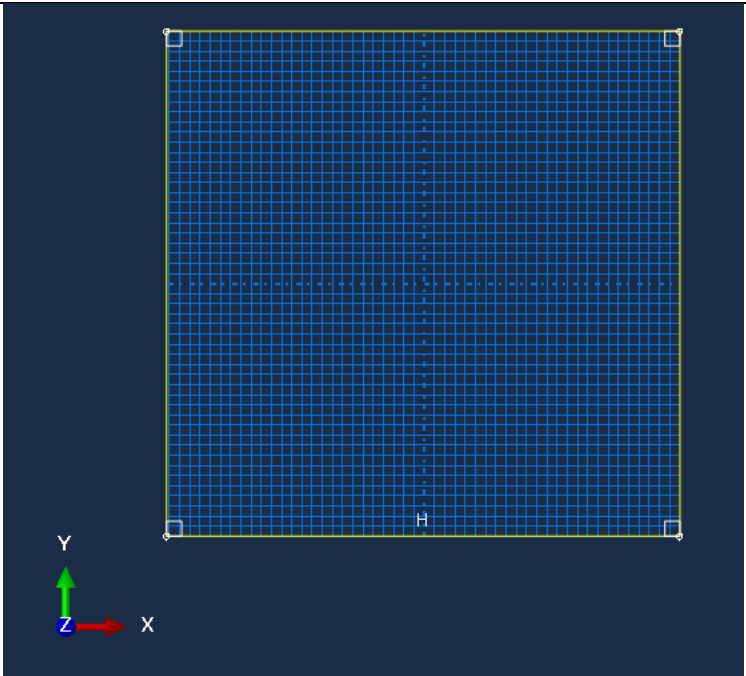
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|   |  |   |
| A2.1                                                                                | A2.2                                                                                | A2.3                                                                                  |
|  |  |  |
| A2.4                                                                                | A2.5                                                                                | A2.6                                                                                  |

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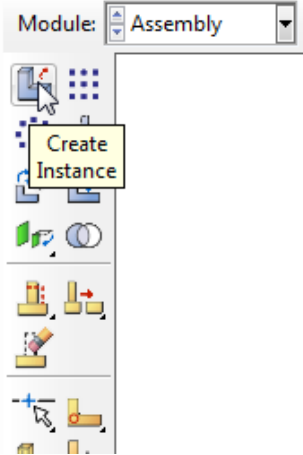
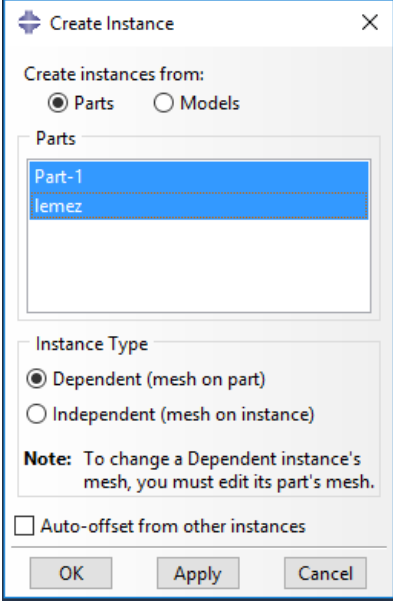
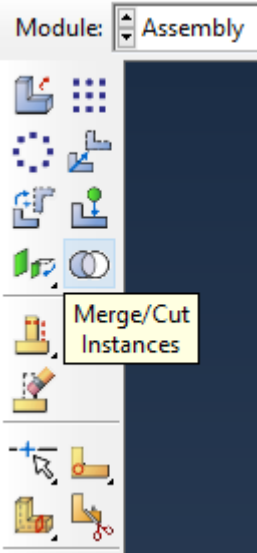
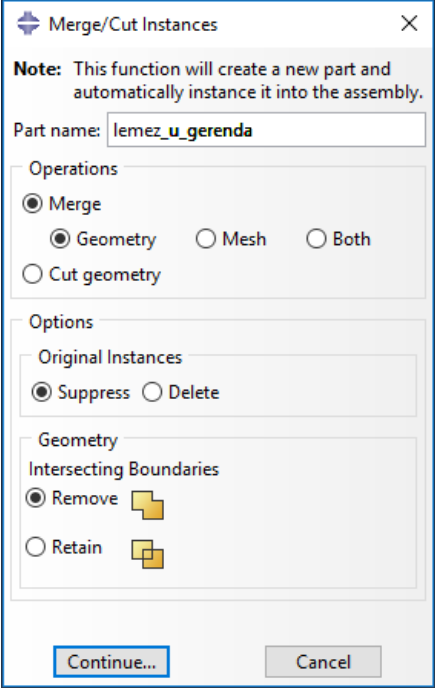
3. Az U gerenda megrajzolása után rajzoljuk meg a lemez geometriáját.

- A Name után írjuk be az alkatrészünk nevét legyen **lemez**.
- A Modeling Space alatt válasszuk ki, hogy síkbeli, azaz **3D** geometriát szeretnénk rajzolni.
- A Type alatt hagyjuk az alapértelmezett kijelölést a **Deformable** előtt, mivel alakváltozásra képes geometriát szeretnénk.
- A Base Feature alatt válasszuk a **Shell**-t. A Type-nál pedig az **Planar** opciót.
- Az Approximate size-ot, tehát a modellünk méretét itt is beállíthatnánk, de erre majd később visszatérünk a segédrács beállításánál, most hagyjuk az alapértelmezett 250-on.
- A fenti beállítások elvégzése után kattintsunk lent a **Continue...** gombra.
- Ezután a **Create Lines: Rectangle** paranccsal rajzoljunk egy téglalapot, aminek a mérete 250x250 mm vagyis a segéd rácshálót keretezi körbe.

Ahhoz, hogy a vázlatból alkatrész legyen a lenti *beviteli mezőben* kattintsunk a Sketch the section for the planar shell melletti **Done** gombra (vagy nyomjuk meg a középső egérgombot) Ennek hatására elkészül a Part-unk, és visszaáll a Part Modul alap eszköztára.

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|   |   |
| <p>A3.1</p>                                                                         | <p>A3.2</p>                                                                          |
|  |  |
| <p>A3.3</p>                                                                         | <p>A3.4</p>                                                                          |

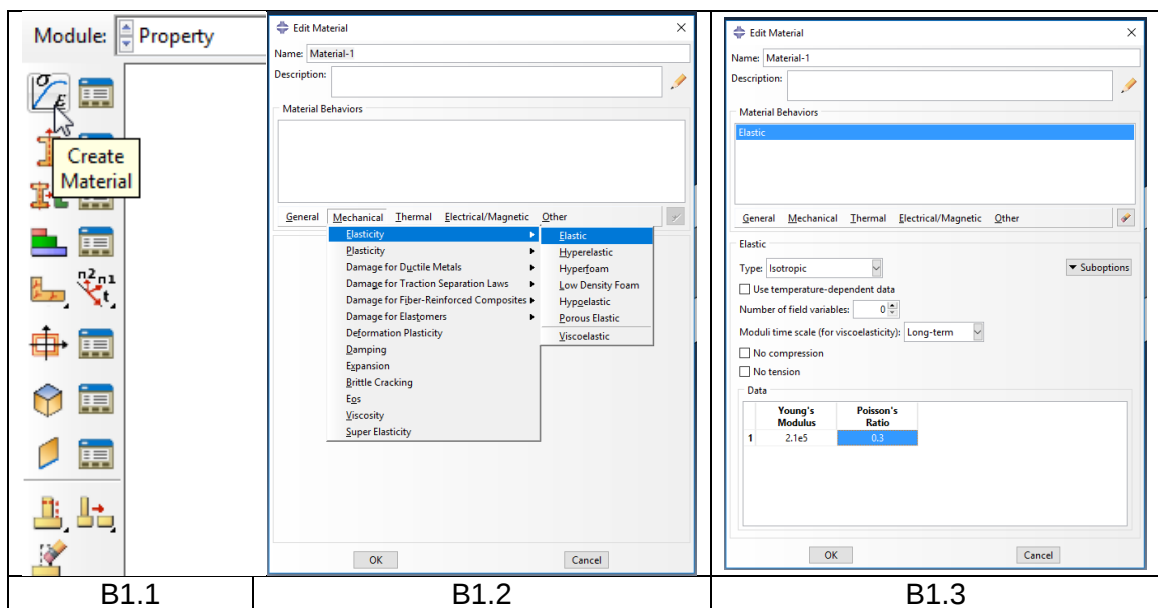
Ennek a lépésnek több alkatrészből álló szerkezetek esetében van igazán jelentősége, mivel itt tudjuk létrehozni az összeállítást. Külön-külön már létrehoztuk a két alkatrészt most készítenünk kell a két alkatrészből egy összeállítást. Ehhez kattintsunk az Assembly modul **Create Instance** ikonjára, majd a Parts menüpontra jelöljük ki mindkét korábban létrehozott alkatrészt majd kattintsunk az **OK** gombra. Ezután a **Merge/Cut Instances** paranccsal egyesítsük a két alkatrészt. A felugró ablakba adjuk meg egy nevet, majd **Continue**. Ezután jelöljük ki a két alkatrészt végül lent a beviteli mezőben a Select the instances to merge –nél kattintsunk a **Done** gombra.

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|   |   |
| C1                                                                                  | C2                                                                                   |
|  |  |
| C3                                                                                  | C4                                                                                   |

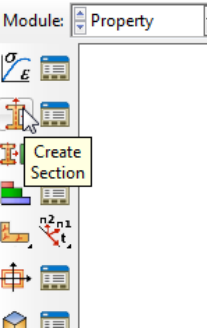
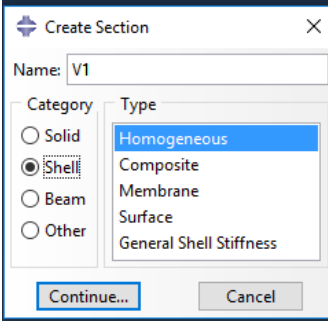
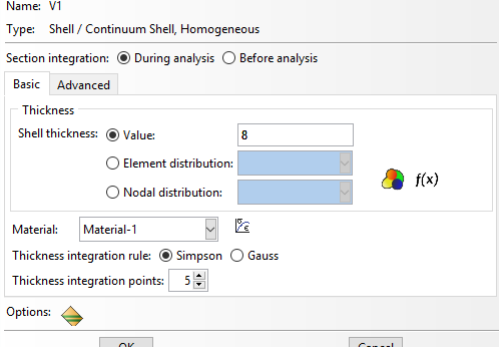
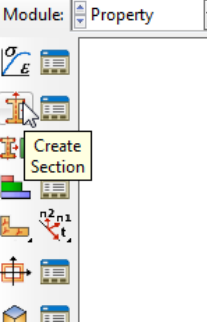
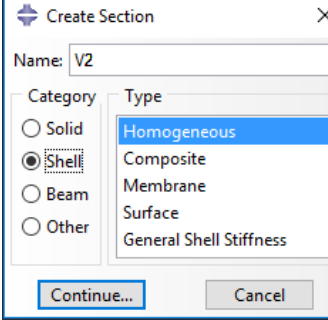
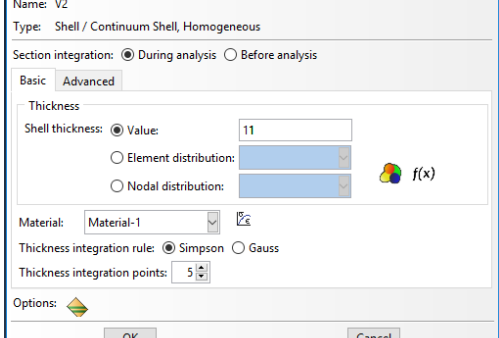
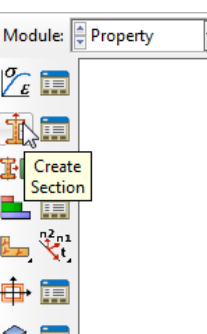
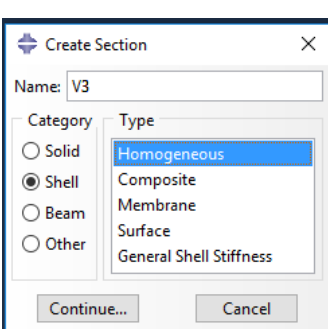
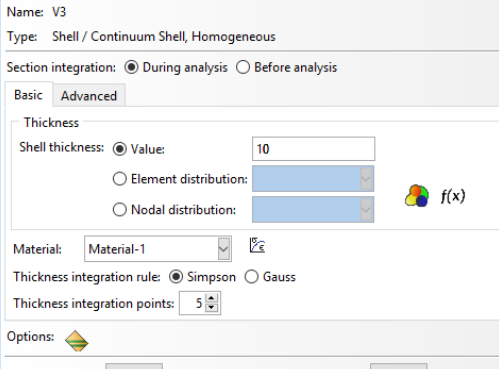
## B MODULE | PROPERTY tulajdonságok megadása

Válasszuk ki fent a Property modult. Itt tudjuk megadni az anyagjellemzőket, illetve rúd esetén a keresztmetszeti jellemzőket. Ehhez az alábbi 3 lépésen kell végmenni:

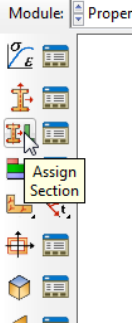
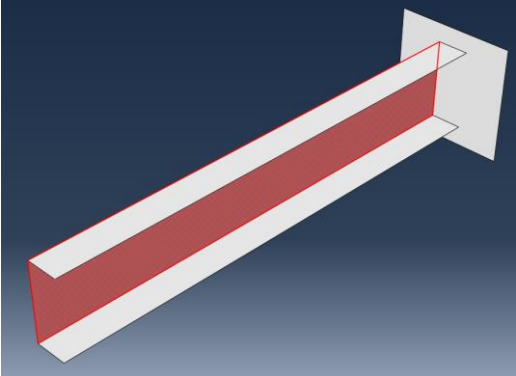
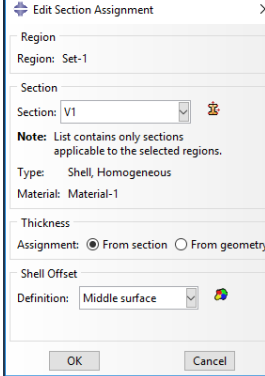
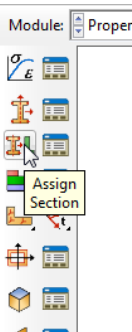
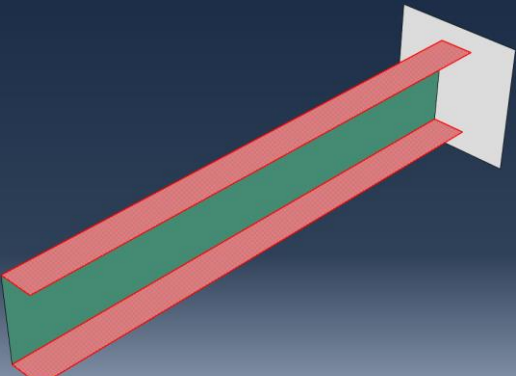
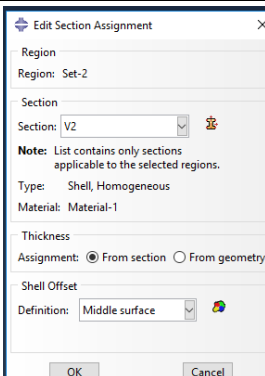
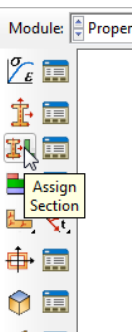
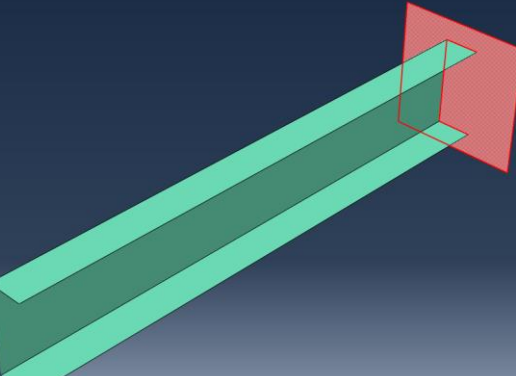
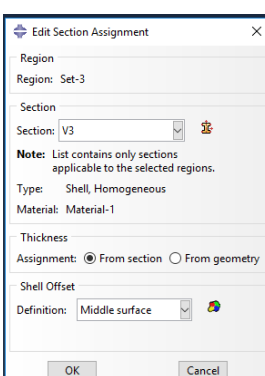
1. Anyag definiálása: Első lépésként egy anyagot kell definiálnunk. Ehhez a Property modul eszköztárából kattintsunk a **Create Material** ikonra. A megjelenő Edit Material ablakban végezzük el a következő beállításokat:
  - Nevezzük el az anyagot: a Name:
  - A lineárisan rugalmas anyagjellemzők megadásához a Material Behaviors mezőben adjuk ki a **Mechanical ► Elasticity ► Elastic** parancsot
  - Az ekkor megjelenő Elastic mezőben az alábbi beállításokat végezzük el:
    - A **Type** mellett hagyjuk az alapértelmezett **Isotropic**-ot (az anyagtulajdonságok irányfüggetlenek)
    - A lenti Data táblázatban a Young's Modulus alá írjuk be a rugalmassági tényezőt, azaz **2.1e5** (MPa) –t, a Poisson's Ratio alá pedig a Poisson tényezőt, azaz **0.3**-at.



2. Section definiálása: A Property Modul eszköztárából kattintsunk a **Create Section** ikonra. Az ekkor megjelenő Create Section ablakban az alábbi beállításokat végezzük el háromszor:
  - Nevezzük el a section-t a Name sornál először **V1**, majd **V2** és **V3** néven
  - A Category alatt válasszuk ki a **Shell** –ot
  - A Type alatt válasszuk a **Homogeneous** –t, ezután kattintsunk a **Continue...** gombra.
  - A felugró ablakban a Shell thickness Value sorba adjuk az egyes Section-ok vastagság értékeit V1-nél **8**-at, V2-nél **11**-et, V3-nál **10**-et.
 Ezután kattintsunk az **OK** gombra, és ismételjük meg a lépéseket míg mindhárom section-t meg nem adtuk.

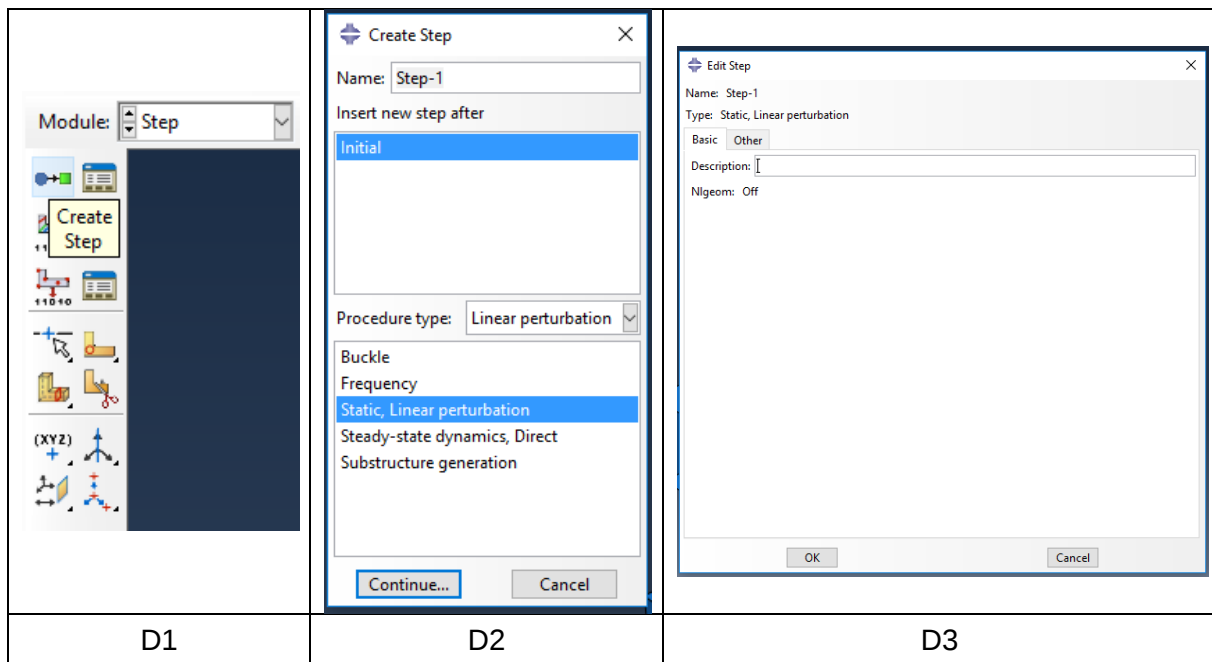
|                                                                                     |                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|    |    |    |
| B2.1                                                                                | B2.2                                                                                | B2.3                                                                                 |
|    |    |   |
| B2.4                                                                                | B2.5                                                                                | B2.6                                                                                 |
|  |  |  |
| B2.7                                                                                | B2.8                                                                                | B2.9                                                                                 |

3. Section-ök geometriához rendelése: Ehhez kattintsunk a Property modul eszköztárából az **Assign Section** ikonra. Ezután jelöljük ki az U gerenda gerincét, majd a lenti beviteli mezőben kattintsunk a **Done** gombra majd a felugró ablakban válasszuk ki a **V1**-es section-t, majd **OK**. Ezt a lépést még kétszer kell megismételnünk. Jelöljük ki az U gerenda övlemezeit és rendeljük hozzá a V2-es section-t. Végül jelöljük ki a 250x250-es lemezt és rendeljük hozzá a V3-as section-t.

|                                                                                     |                                                                                     |                                                                                       |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|    |    |    |
| B3.1                                                                                | B3.2                                                                                | B3.3                                                                                  |
|    |    |    |
| B3.4                                                                                | B3.5                                                                                | B3.6                                                                                  |
|  |  |  |
| B3.7                                                                                | B3.8                                                                                | B3.9                                                                                  |

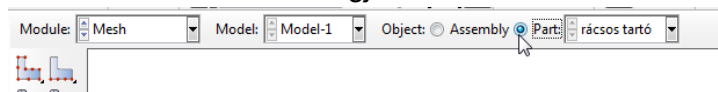
## D MODULE | STEP lépések megadása

A Step modulban a végrehajtandó vizsgálat(ok) típusát (pl. statikus, dinamikus, hőtan...), azok részleteit és sorrendjét tudjuk beállítani. Jelenleg 1 db statikus lépést kell definiálnunk. Ehhez kattintsunk a Step modul **Create Step** ikonjára. a megjelenő Create Step ablakban nevezzük el a lépést: a Name -nél. A Procedure type-nál válasszuk a **Linear perturbation**-t. Ezután kattintsunk a **Continue...** gombra, majd a megjelenő Edit Setup ablakban hagyjunk mindent alapértelmezésen, csak **OK**-zuk le.



|          |                      |                         |
|----------|----------------------|-------------------------|
| <b>F</b> | <b>MODULE   MESH</b> | <b>háló elkészítése</b> |
|----------|----------------------|-------------------------|

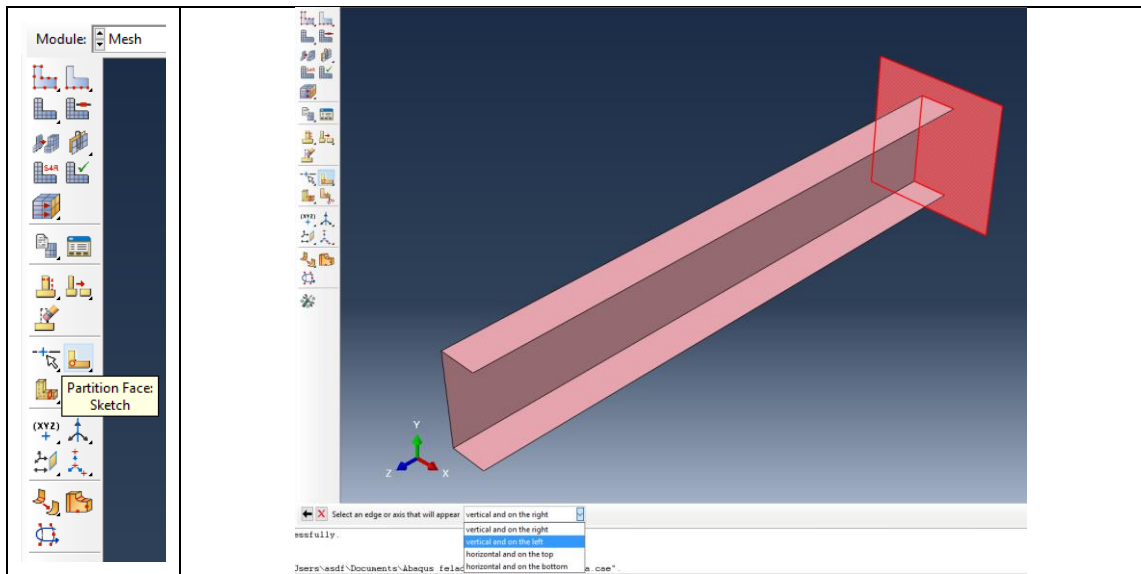
A végeselem hálót a Mesh modulban tudjuk elkészíteni. Legelőször fent az Object-et állítsuk át Part-ra, aminek hatására a Part mellett megjelenik a rácsos tartó felirat.



Ezután a hálózást az alábbi lépésekben végezzük el:

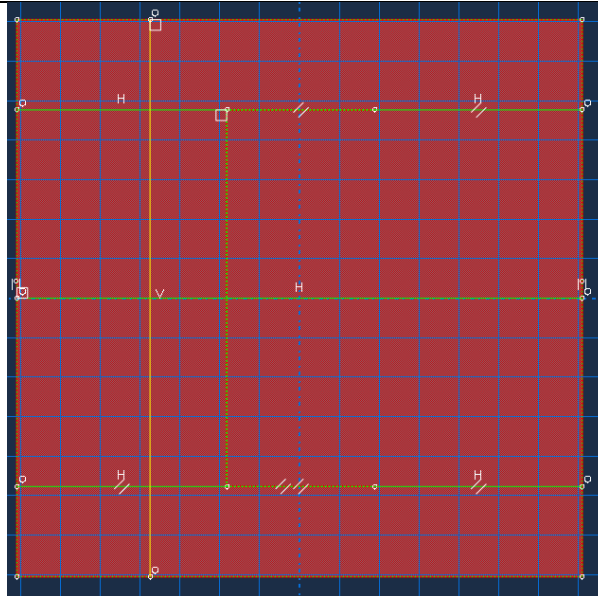
1. Lemez felület felvágása:

Első lépésként mivel még nem hoztuk létre azokat a pontokat, amikre a terhelések meg kell adnunk ezért elsőként felvágjuk a lemez felületét úgy, hogy ezek a pontok kiadódjanak. Ehhez kattintsunk a **Partition Face: Sketch** ikonra. Majd jelöljük ki az a felületet, amit fel szeretnénk vágni, tehát kattintsunk, a lemezre majd középsőgombbal fogadjuk el a kijelölést. Ezután a lenti beviteli mezőben válasszuk ki a **vertical and on the left** opciót ezután pedig kattintsunk az U gerenda gerincének lemezzel érintkező vonalára. Ekkor visszkapjuk a sketch modult, amiben rajzoljuk meg a **Create Lines: Connected** paranccsal azokat a vonalakat, amik mentén a felületet felvágjuk (lásd a lenti ábrán). Ezután az **Add Dimension** paranccsal méretezzük be a berajzolt függőleges vonalat a gerinchez képest **25.16** mm-re. Végül kattintsunk a beviteli mezőben a **Done** gombra.

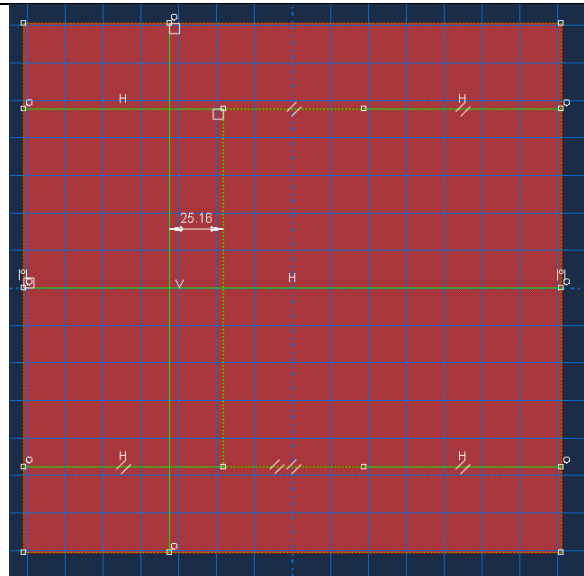


F1.1

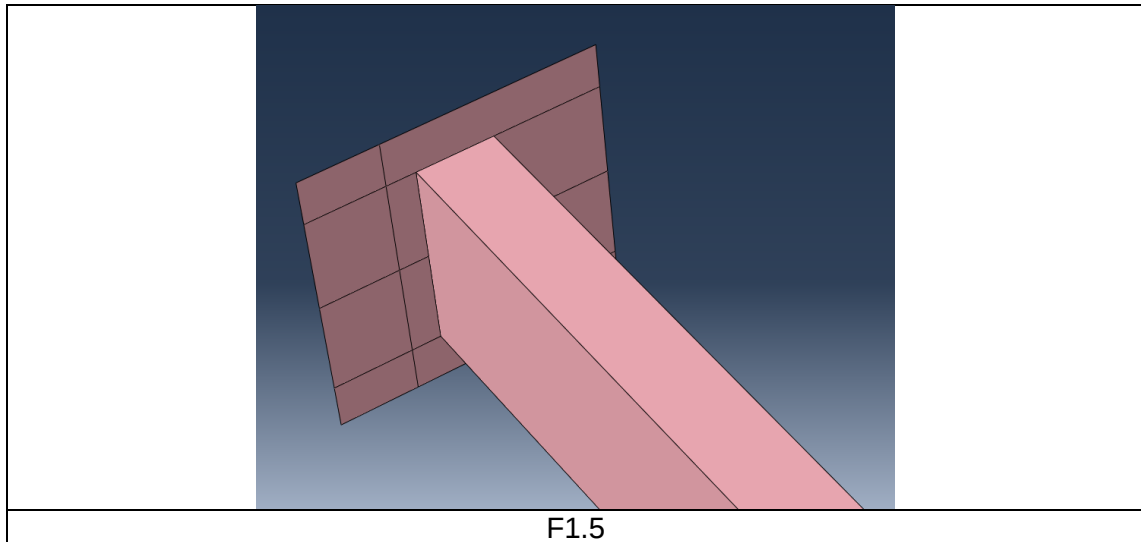
F1.2



F1.3

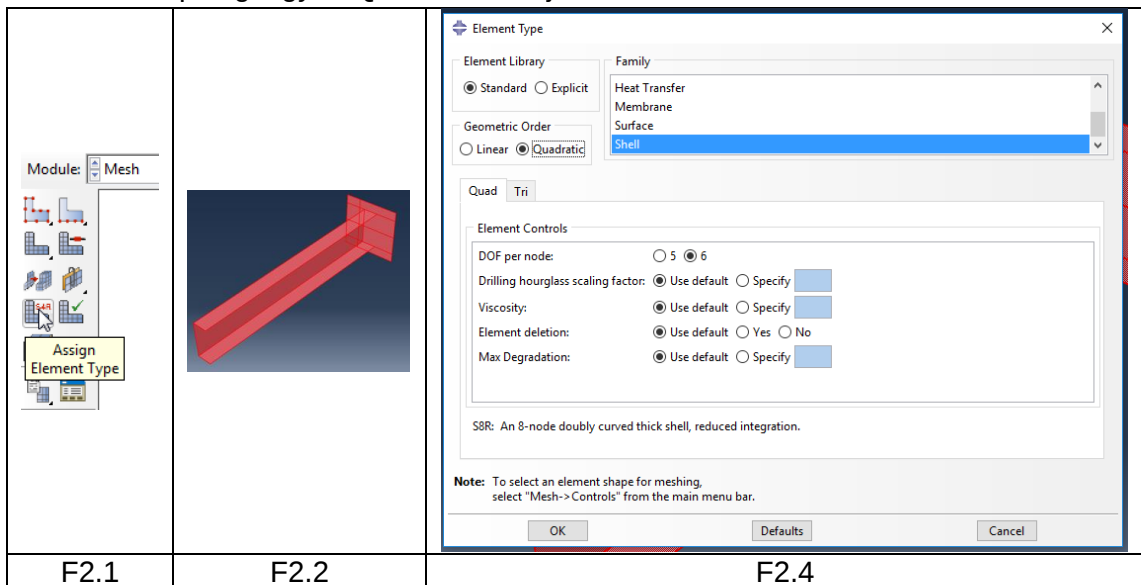


F1.4



## 2. Elemtípus megadása:

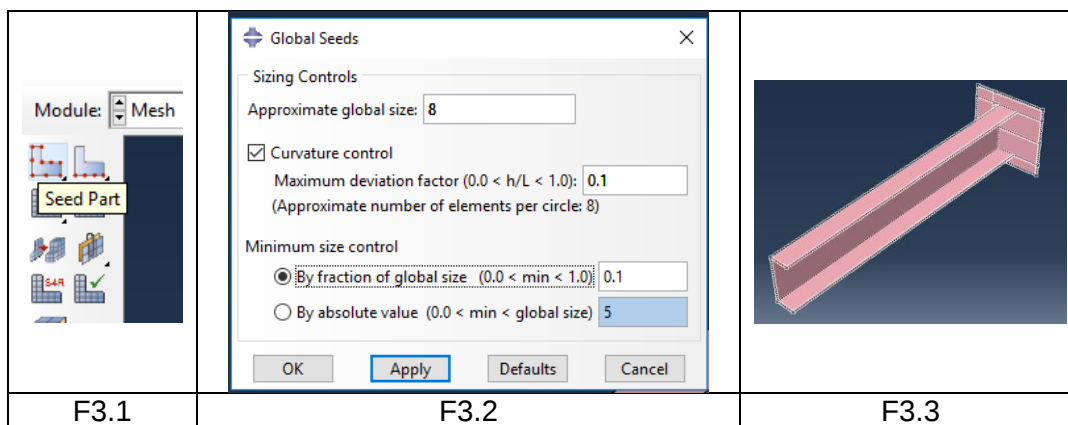
- Kattintsunk a Mesh modul **Assign Element Type** ikonjára.
- Jelöljük ki a teljes geometriát.
- A lenti beviteli mezőben kattintsunk a **Done** gombra
- A megjelenő Element Type ablakban a Family-t állítsuk **Shell**-re, a Geometric Order-t pedig legyen **Quadratic**, majd **OK**-zuk le az ablakot.



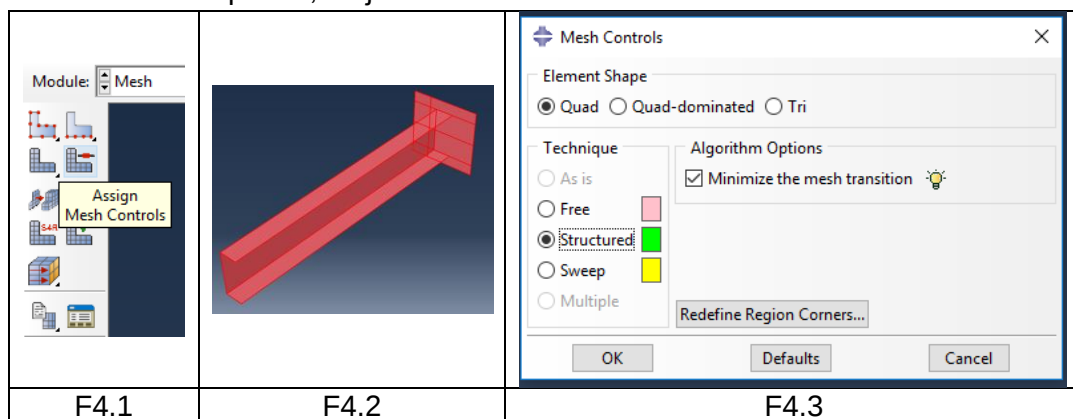
## 3. Elemméret megadása:

Ehhez az alábbi lépéseket végezzük el:

- Kattintsunk a Mesh modul **Seed Part** ikonjára.
- A megjelenő Global Seeds ablakban az Approximate global size mezőben írjunk be **8**-at. Ezután **OK**-zuk le az ablakot.

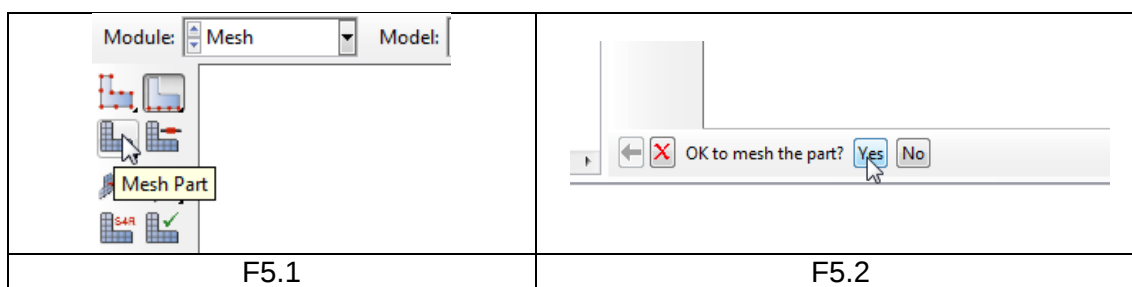


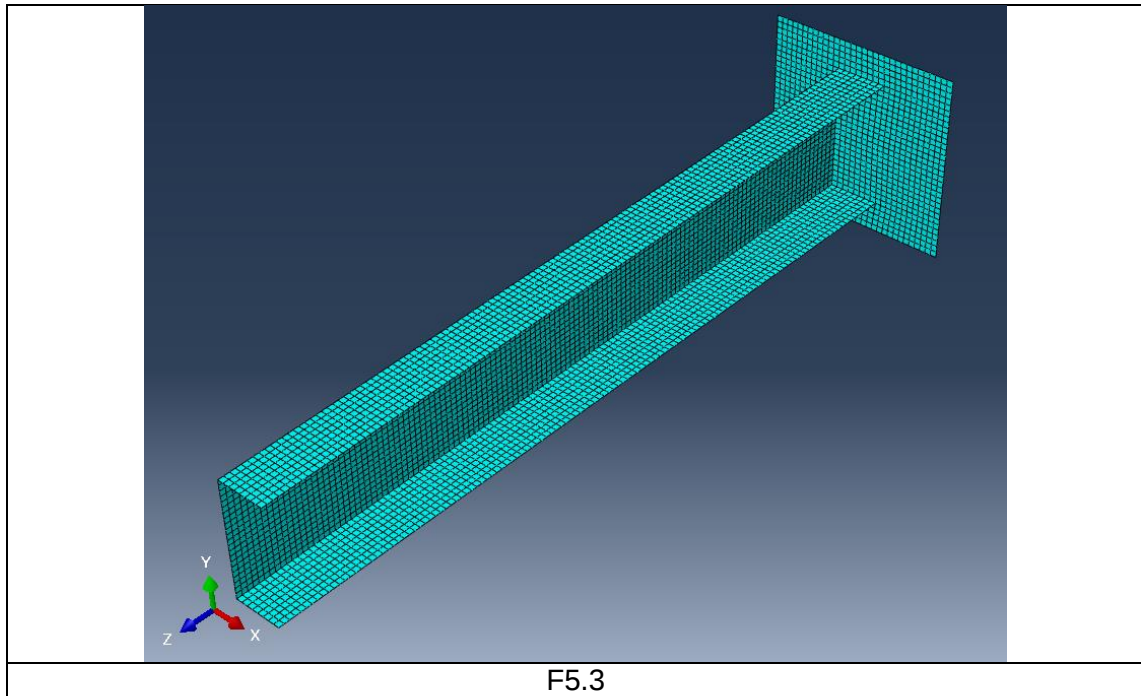
4. Négyszög alakú strukturált háló megadása: Kattintsunk az **Assign Mesh Controls** ikonra ezután jelöljük ki a teljes geometriát majd kattintsunk a középső gombbal. A felugró Mesh Controls ablakban az Element Shape-nél állítsuk be a **Quad**-ot a Technique-nél pedig a **Structured** menüpontot, majd kattintsunk az **OK**-ra.



5. Végeselem háló elkészítése:

A végeselem háló elkészítéséhez kattintsunk a Mesh modul eszköztárában a **Mesh Part** ikonra, majd a lenti beviteli mezőben az OK to mesh the part? mellett a **Yes** gombra.





#### 6. Hálótulajdonságok lekérdezése (opcionális)

A csomópontok és végelemek számának ellenőrzéséhez a **Tools ► Query...** Parancsot használhatjuk. A felugró Query ablakban a General Queries mezőben kattintsunk a Mesh-re, majd a lenti beviteli mezőt a Query entire part-on hagyva a **Done** gombra. Ekkor a lenti párbeszédablakban megjelenik a csomópont szám (Total number of nodes) és az elemszám (Total number of elements).

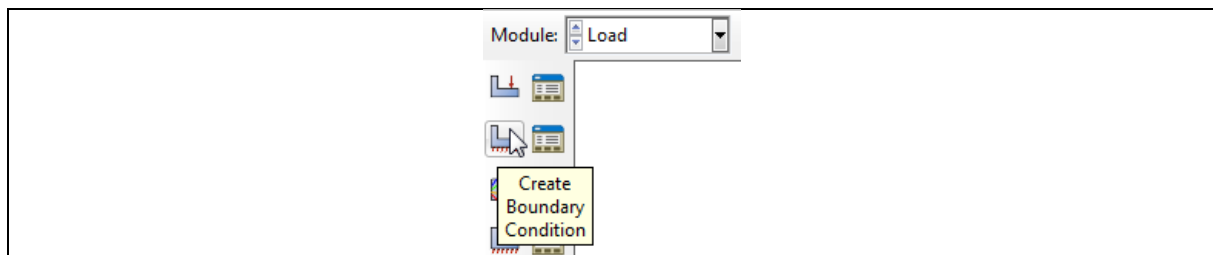
### **E MODULE | LOAD** peremfeltételek megadása

A Load modulban tudjuk megadni a kinematikai peremfeltételeket (megfogásokat) és dinamikai peremfeltételeket (terheléseket). Jelen feladatban 1 megfogást és 4 terhelést kell definiálni.

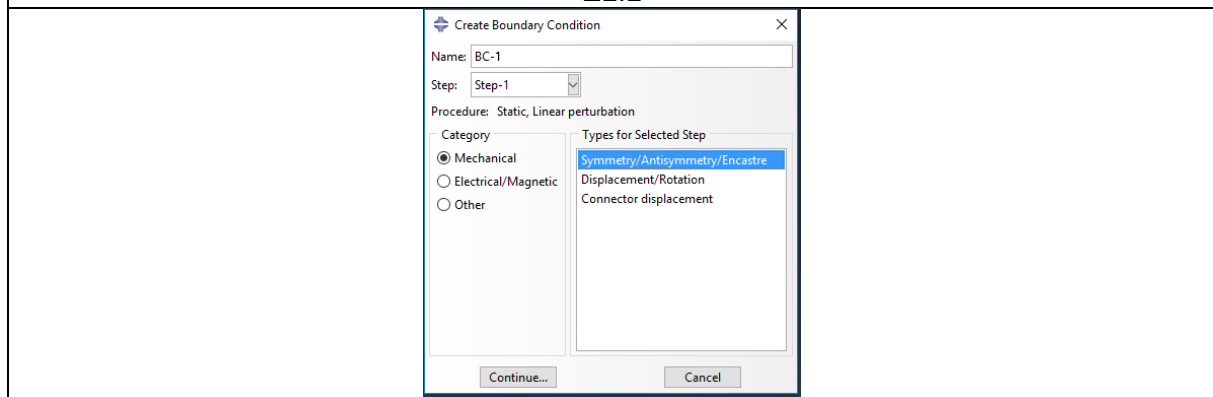
#### 1. megfogások definiálása: (az alábbi lépéseket kétszer kell végcsinálni)

- Kattintsunk a Load modul **Create Boundary Condition** ikonjára.
- A megjelenő Create Boundary Condition ablakban nevezzük el a megfogást, a Category-t hagyjuk az alapértelmezett Mechanical-on, a Types for Selected Step alatt pedig válasszuk ki a **Symmetry/Antisymmetry/Encastre**-t. Ezután kattintsunk a **Continue...** gombra.
- Jelöljük ki a rajzon a megfogás megfelelő helyét (kijelöléskor egy piros vonal jelenik meg a kijelölés helyén).
- A lenti beviteli mezőben kattintsunk a **Done**-re
- Az ekkor megjelenő Edit Boundary Condition ablakban a fix megfogás esetén válasszuk az **ENCASTRE (U1=U2=U3=UR1=UR2=UR3=0)**. OK-zuk le az ablakot.

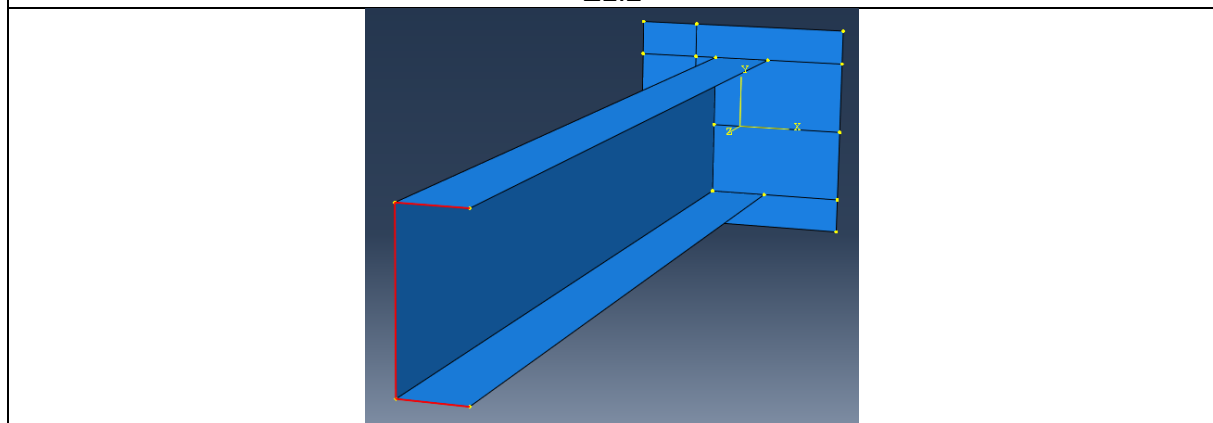
### befalazás



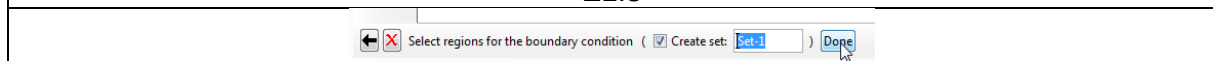
E1.1



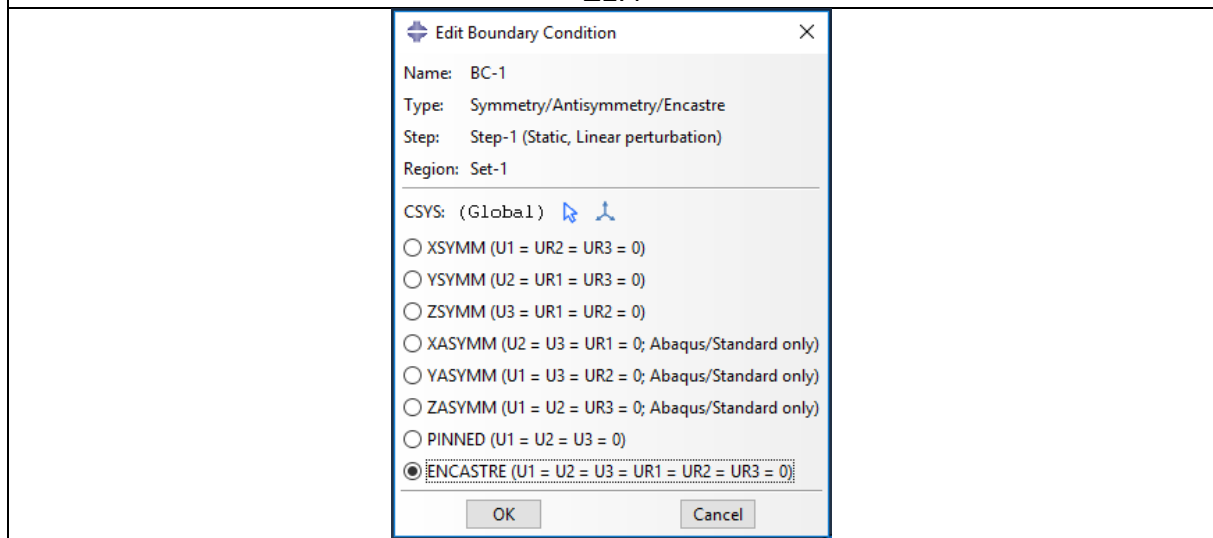
E1.2



E1.3



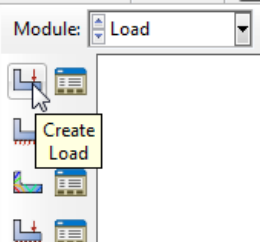
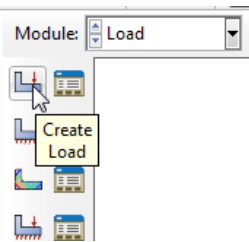
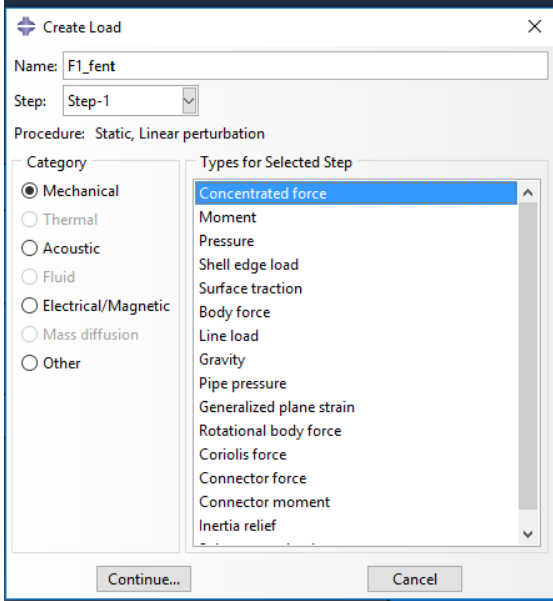
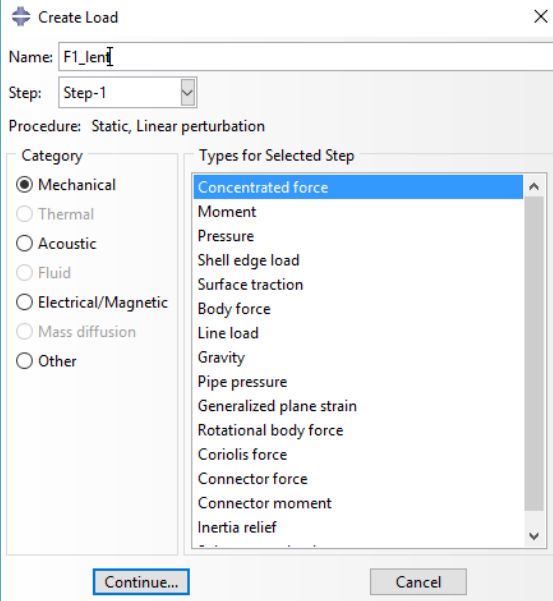
E1.4

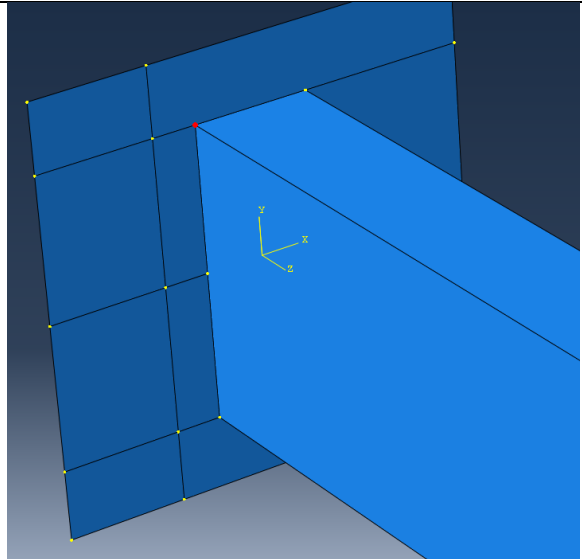
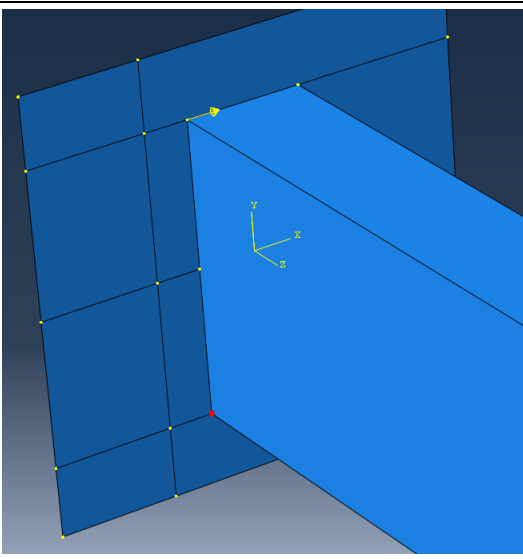
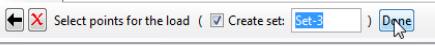
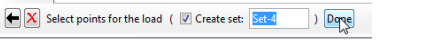
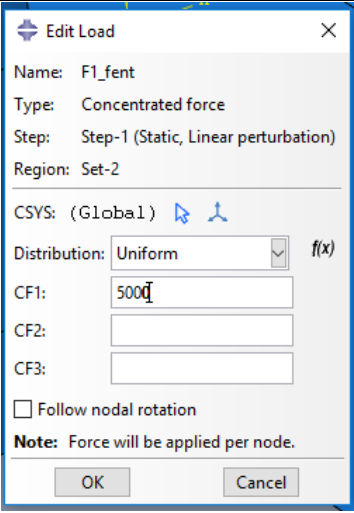
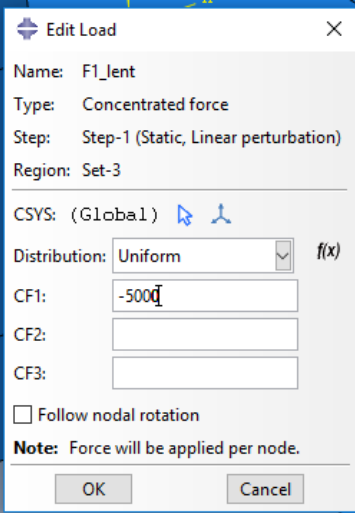


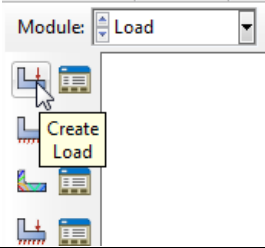
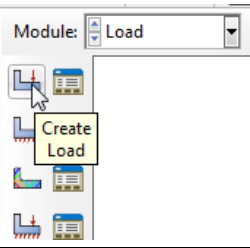
E1.5

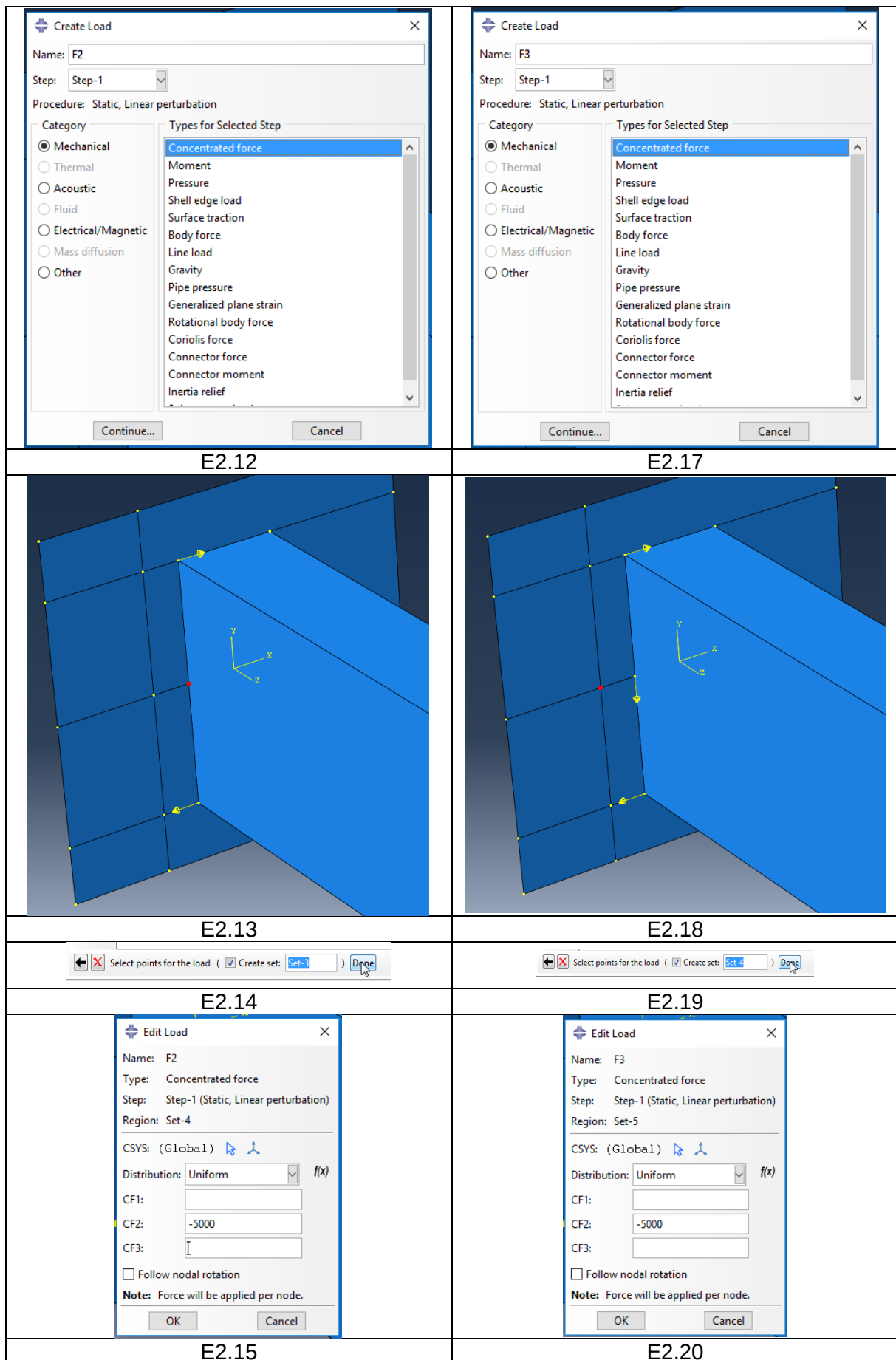
2. terhelések definiálása: (a lenti lépéseket négyszer kell megcsinálni)

- Kattintsunk a Load modul **Create Load** ikonjára.
- A megjelenő Create Load ablakban nevezzük el megoszló terhelésnek, az erőt pedig koncentrált erőnek. . A Category-t hagyjuk az alapértelmezett Mechanical-on, a Types for Selected Step alatt pedig válasszuk ki a **Concentrated Force**-ot koncentrált erő megadásnál. Ezután kattintsunk a **Continue...** gombra.
- Jelöljük ki a rajzon a koncentrált erő helyét. (kijelöléskor egy kis piros pont jelenik meg a kijelölés helyén).
- A lenti beviteli mezőben kattintsunk a **Done**-re
- Az ekkor megjelenő Edit Load ablakban adjuk meg az erőkomponensek nagyságát N-ban: (**CF1=5000**, majd **CF1=-5000**, ezután **CF2=-5000** végül **CF2=-5000**)

|                                                                                                                                            |                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>F1 erőpár fent</b></p>  | <p style="text-align: center;"><b>F1 erőpár lent</b></p>  |
| E2.1                                                                                                                                       | E2.6                                                                                                                                        |
|                                                          |                                                          |
| E2.2                                                                                                                                       | E2.7                                                                                                                                        |

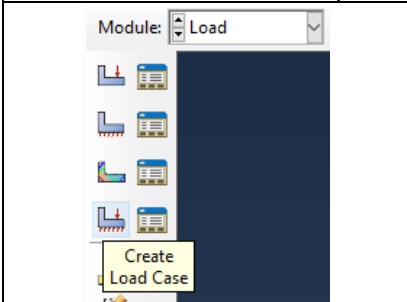
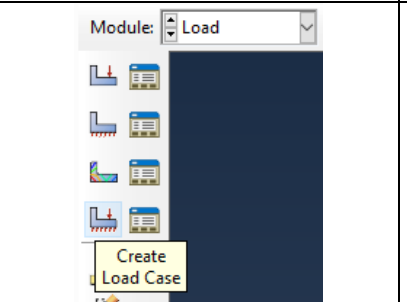
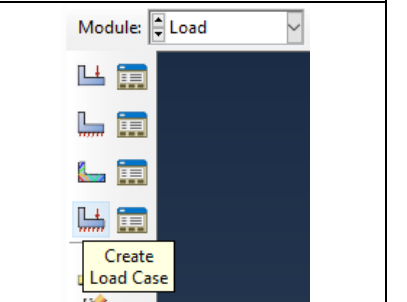
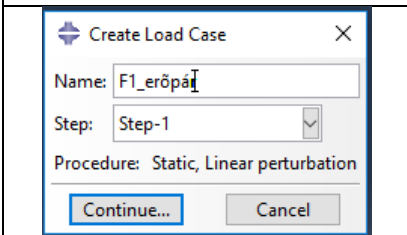
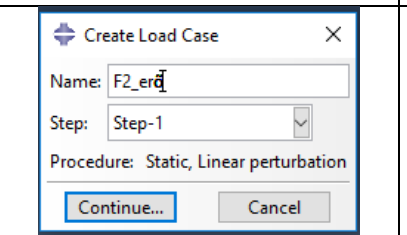
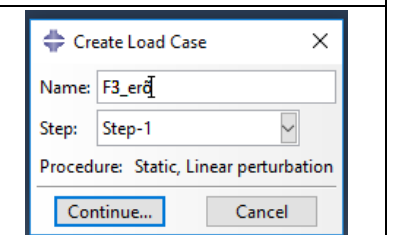
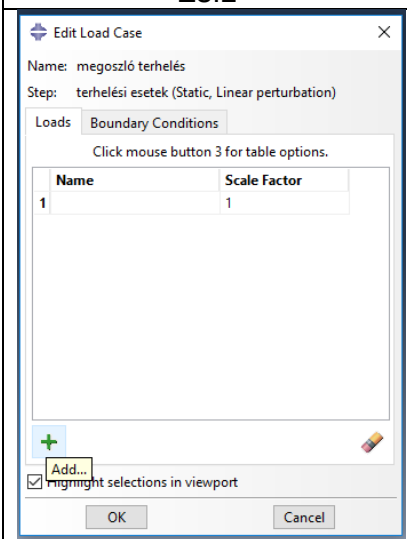
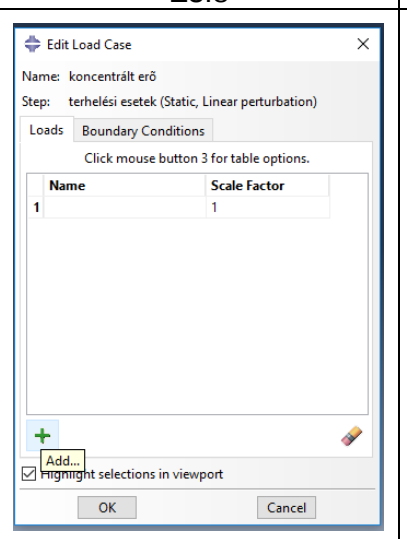
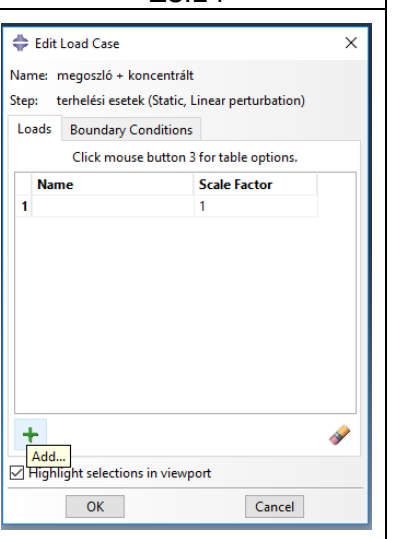
|                                                                                                |                                                                                                 |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|               |               |
| <p>E2.3</p>   | <p>E2.8</p>   |
| <p>E2.4</p>  | <p>E2.9</p>  |
| <p>E2.5</p>                                                                                    | <p>E2.10</p>                                                                                    |

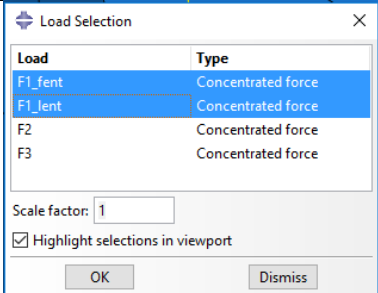
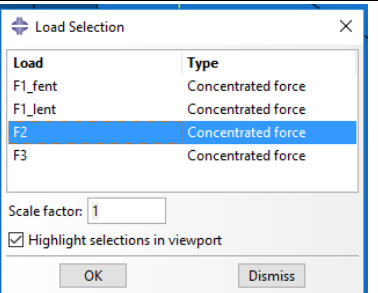
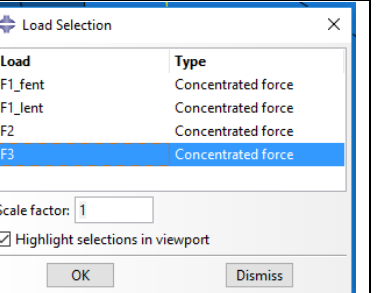
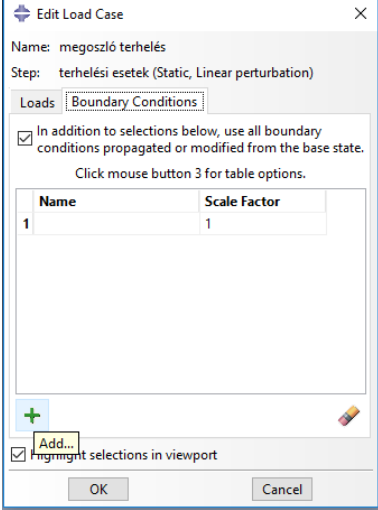
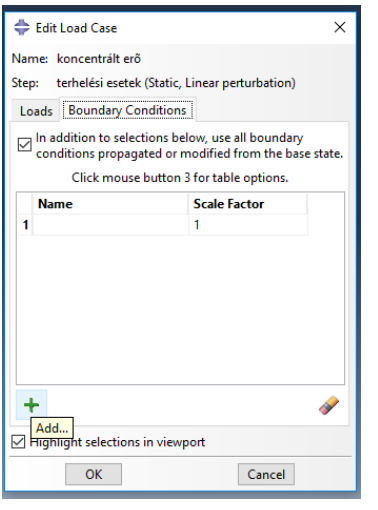
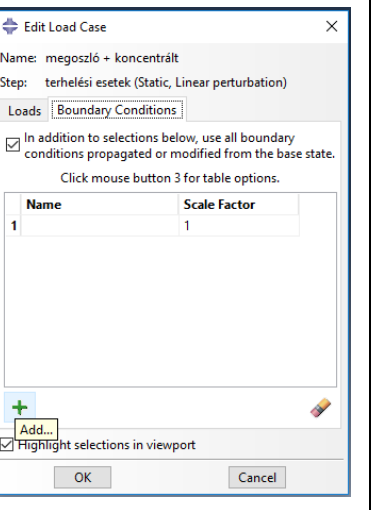
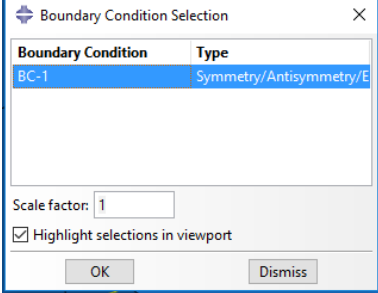
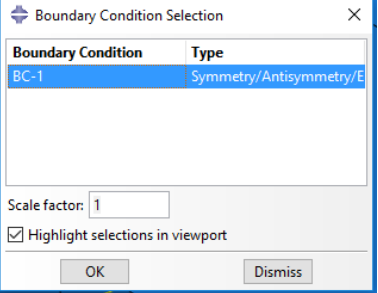
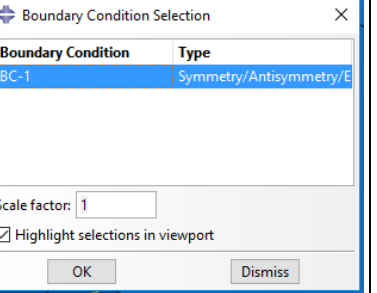
|                                                                                                          |                                                                                                           |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <p><b>F2 erő</b></p>  | <p><b>F3 erő</b></p>  |
| <p>E2.11</p>                                                                                             | <p>E2.16</p>                                                                                              |



### 3. Terhelési esetek megadása:

- Kattintsunk a Load modul **Create Load Case** ikonjára.
- A megjelenő Create Load Case ablakban nevezzük el terhelési eseteket. Ezután kattintsunk a **Continue...** gombra.
- Az Edit Load Case ablakban a Load fülön kattintsunk a **zöld + ikonra** (Add). Jelöljük ki a listából a terhelési esetnek megfelelő terhelést. Ezután **OK** gombra kattintsunk.
- Az Edit Load Case ablakban lépünk át a Boundary Conditions fülre kattintsunk a **zöld + ikonra** (Add). Jelöljük ki a listából a terhelési esetnek megfelelő megfogásokat. Ezután **OK** gombra kattintsunk.
- Majd kattintsunk a **OK**-ra

| 1. terhelési eset - F1 erőpár                                                       | 2. terhelési eset - F2 erő                                                           | 3. terhelési eset – F3 erő                                                            |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|    |    |    |
| E3.1                                                                                | E3.7                                                                                 | E3.13                                                                                 |
|   |   |   |
| E3.2                                                                                | E3.8                                                                                 | E3.14                                                                                 |
|  |  |  |
| E3.3                                                                                | E3.9                                                                                 | E3.15                                                                                 |

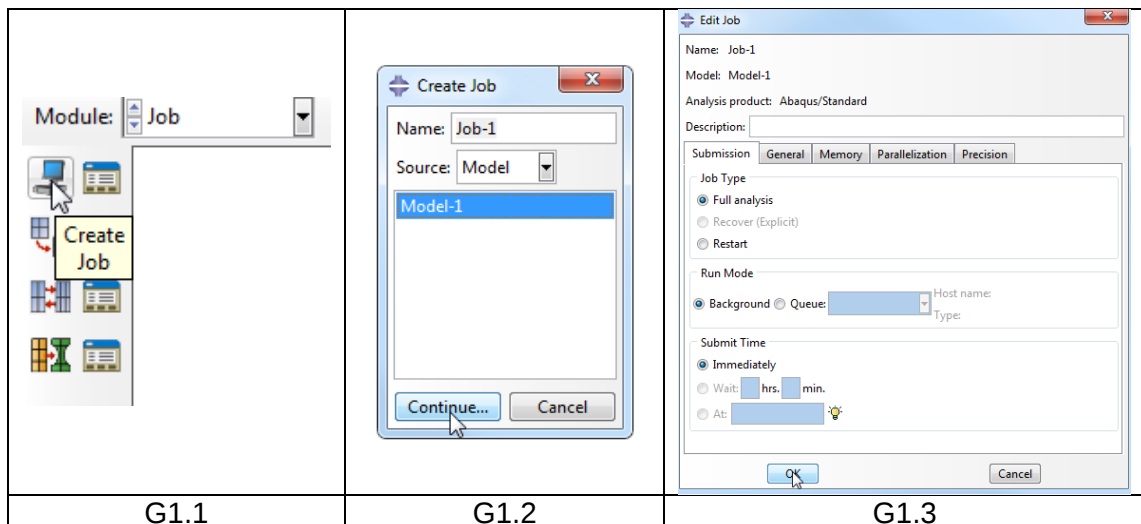
|  <p><b>Load Selection</b></p> <table border="1"> <thead> <tr> <th>Load</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>F1_fent</td> <td>Concentrated force</td> </tr> <tr> <td>F1_lent</td> <td>Concentrated force</td> </tr> <tr> <td>F2</td> <td>Concentrated force</td> </tr> <tr> <td>F3</td> <td>Concentrated force</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p>                                                                                                                                                   | Load                    | Type         | F1_fent | Concentrated force      | F1_lent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Concentrated force | F2           | Concentrated force | F3                      | Concentrated force                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  <p><b>Load Selection</b></p> <table border="1"> <thead> <tr> <th>Load</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>F1_fent</td> <td>Concentrated force</td> </tr> <tr> <td>F1_lent</td> <td>Concentrated force</td> </tr> <tr> <td>F2</td> <td>Concentrated force</td> </tr> <tr> <td>F3</td> <td>Concentrated force</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p> | Load         | Type | F1_fent                 | Concentrated force | F1_lent | Concentrated force | F2 | Concentrated force | F3 | Concentrated force |  <p><b>Load Selection</b></p> <table border="1"> <thead> <tr> <th>Load</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>F1_fent</td> <td>Concentrated force</td> </tr> <tr> <td>F1_lent</td> <td>Concentrated force</td> </tr> <tr> <td>F2</td> <td>Concentrated force</td> </tr> <tr> <td>F3</td> <td>Concentrated force</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p> | Load | Type | F1_fent | Concentrated force | F1_lent | Concentrated force | F2 | Concentrated force | F3 | Concentrated force |
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| E3.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | E3.10                   | E3.16        |         |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |              |                    |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |      |                         |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
|  <p><b>Edit Load Case</b></p> <p>Name: megoszló terhelés</p> <p>Step: terhelési esetek (Static, Linear perturbation)</p> <p>Loads Boundary Conditions</p> <p><input checked="" type="checkbox"/> In addition to selections below, use all boundary conditions propagated or modified from the base state.</p> <p>Click mouse button 3 for table options.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Scale Factor</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>+</p> <p>Add...</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Cancel</p> | Name                    | Scale Factor | 1       | 1                       |  <p><b>Edit Load Case</b></p> <p>Name: koncentrált erő</p> <p>Step: terhelési esetek (Static, Linear perturbation)</p> <p>Loads Boundary Conditions</p> <p><input checked="" type="checkbox"/> In addition to selections below, use all boundary conditions propagated or modified from the base state.</p> <p>Click mouse button 3 for table options.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Scale Factor</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>+</p> <p>Add...</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Cancel</p> | Name               | Scale Factor | 1                  | 1                       |  <p><b>Edit Load Case</b></p> <p>Name: megoszló + koncentrált</p> <p>Step: terhelési esetek (Static, Linear perturbation)</p> <p>Loads Boundary Conditions</p> <p><input checked="" type="checkbox"/> In addition to selections below, use all boundary conditions propagated or modified from the base state.</p> <p>Click mouse button 3 for table options.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Scale Factor</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>+</p> <p>Add...</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Cancel</p> | Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Scale Factor | 1    | 1                       |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
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| E3.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | E3.11                   | E3.17        |         |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |              |                    |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |      |                         |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
|  <p><b>Boundary Condition Selection</b></p> <table border="1"> <thead> <tr> <th>Boundary Condition</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>BC-1</td> <td>Symmetry/Antisymmetry/E</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p>                                                                                                                                                                                                                                                                                 | Boundary Condition      | Type         | BC-1    | Symmetry/Antisymmetry/E |  <p><b>Boundary Condition Selection</b></p> <table border="1"> <thead> <tr> <th>Boundary Condition</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>BC-1</td> <td>Symmetry/Antisymmetry/E</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p>                                                                                                                                                                                                                                                                               | Boundary Condition | Type         | BC-1               | Symmetry/Antisymmetry/E |  <p><b>Boundary Condition Selection</b></p> <table border="1"> <thead> <tr> <th>Boundary Condition</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>BC-1</td> <td>Symmetry/Antisymmetry/E</td> </tr> </tbody> </table> <p>Scale factor: 1</p> <p><input checked="" type="checkbox"/> Highlight selections in viewport</p> <p>OK Dismiss</p>                                                                                                                                                                                                                                                                                      | Boundary Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Type         | BC-1 | Symmetry/Antisymmetry/E |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
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| Boundary Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Type                    |              |         |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |              |                    |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |      |                         |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
| BC-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Symmetry/Antisymmetry/E |              |         |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |              |                    |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |      |                         |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |
| E3.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | E3.12                   | E3.18        |         |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |              |                    |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |      |                         |                    |         |                    |    |                    |    |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |         |                    |         |                    |    |                    |    |                    |

## G MODULE | JOB feladat megoldása

A feladatot a Job modulba átlépve tudjuk lefuttatni. Az ehhez szükséges lépések:

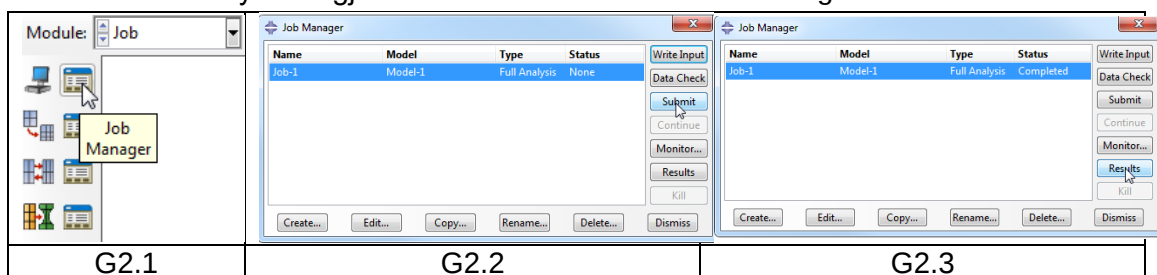
### 1. Feladat definiálása:

- A Job modul eszköztárából kattintsunk a **Create Job** ikonra
- A megjelenő Create Job ablakban kattintsunk a **Continue...** gombra
- A megjelenő Edit Job ablakban hagyjunk mindent alapértelmezésen és **OK**-zuk le



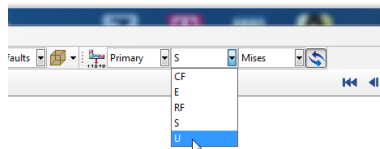
## 2. Feladat lefuttatása:

- A Job modul eszköztárából kattintsunk a **Job Manager** ikonra
- A megjelenő Job manager ablakban alpból ki van választva az előbb definiált 1 db feladat (Job-1). Kattintsunk a **Submit** gombra.
- Ha a Status alatt megjelenik a Completed felirat, akkor a feladat sikeresen lefutott. Az eredmények megjelenítéséhez kattintsunk a **Results** gombra.

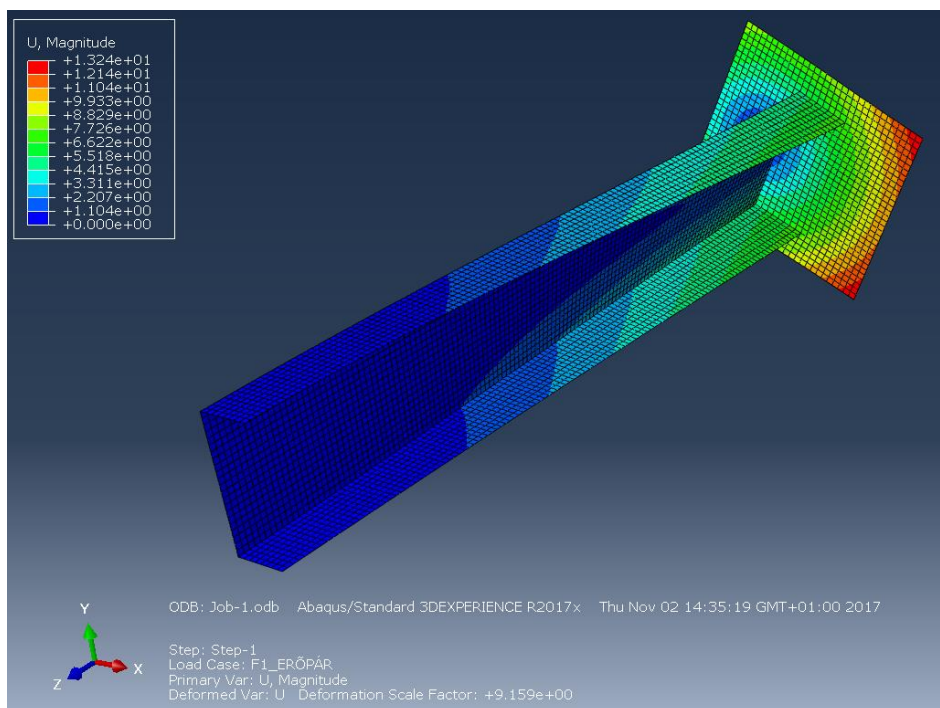


## H MODULE | VISUALIZATION eredmények megjelenítése

A **Results** gombra kattintva automatikusan a **Visualisation** modulba kerülünk. Fent válasszuk ki az U-t vagy az S-t annak megfelelően, hogy az elmozdulást, vagy a feszültséget szeretnénk megjeleníteni. Először válasszuk az U-t.

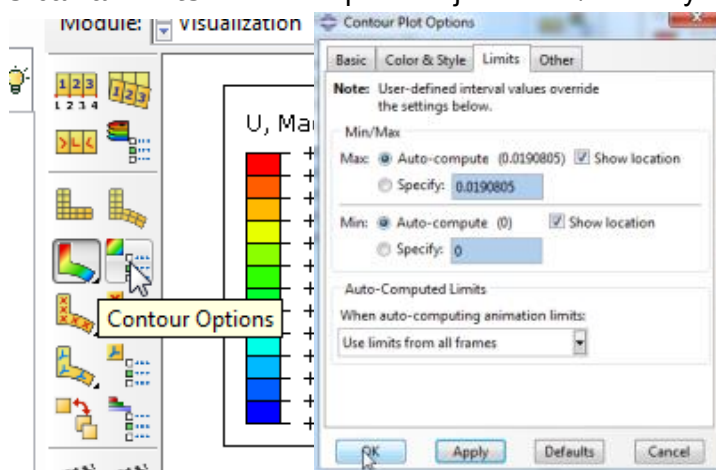


A **Plot Contours on Deformed Shape** ikonra kattintva a deformált alakot láthatjuk.



Bal felül látható színskála alapján a maximális elmozdulás 0,2912 mm.

A **Contour Options**-ban a **Limits** fülön bekapcsolhatjuk a max/min helyek megjelenítését.



Az elmozdulások kiértékelése után nézzük meg a redukált feszültség eloszlást.

