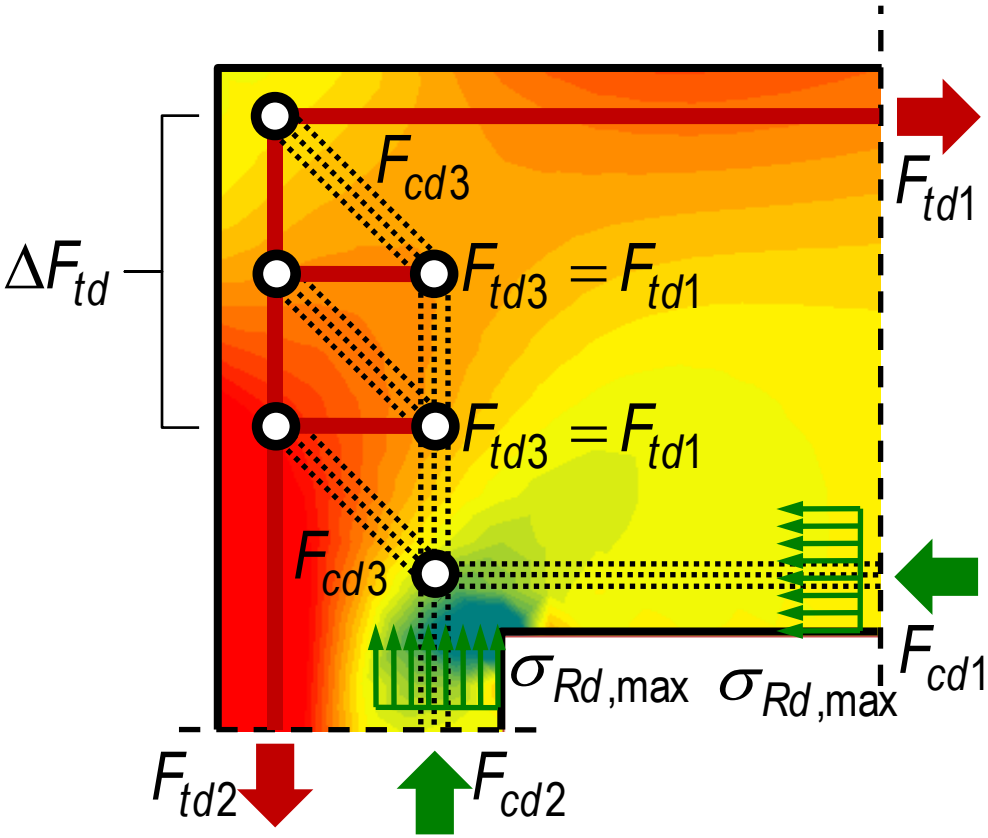
VII.

Reinforced Concrete Structures III.

Vasbetonszerkezetek III.

- Rúdszerkezetek, keretek csomóponti kialakításai, szerkesztési szabályok I. -



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www.epito.eng.unideb.hu

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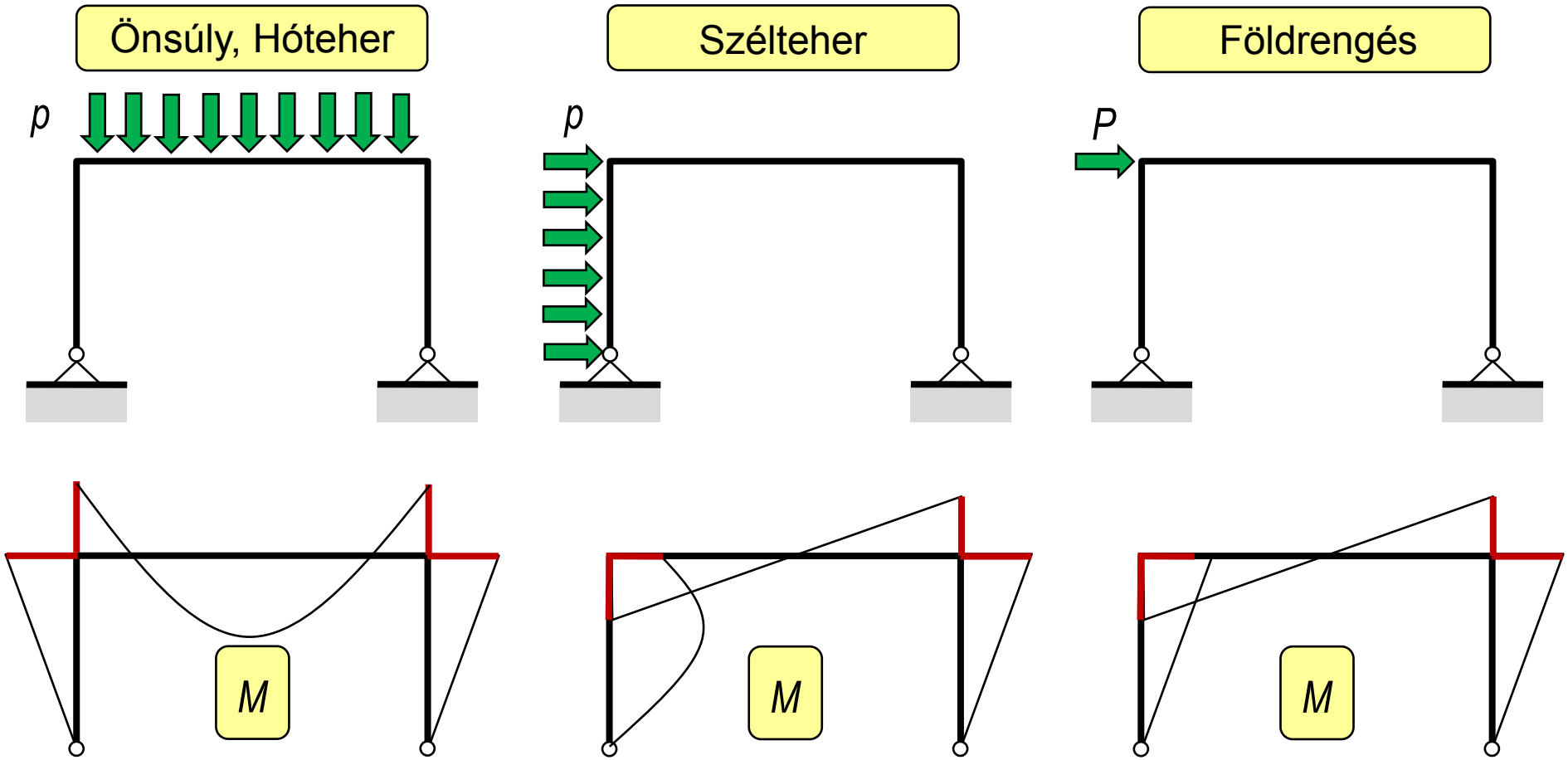
Typical actions and loads of RC frames - bending moments

Vasbeton keretek jellemző terhei és hatásai – hajlítónyomatékok



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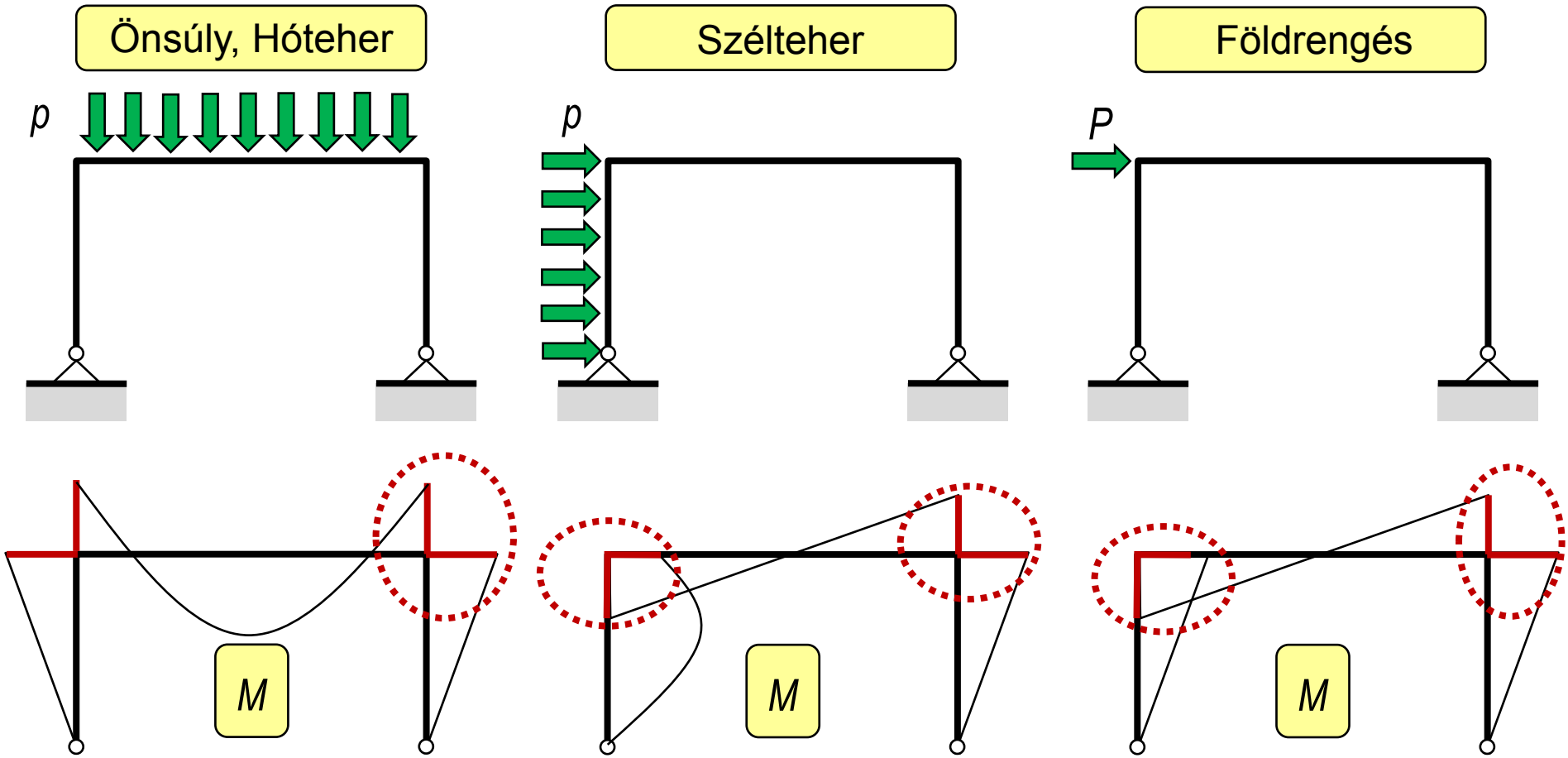

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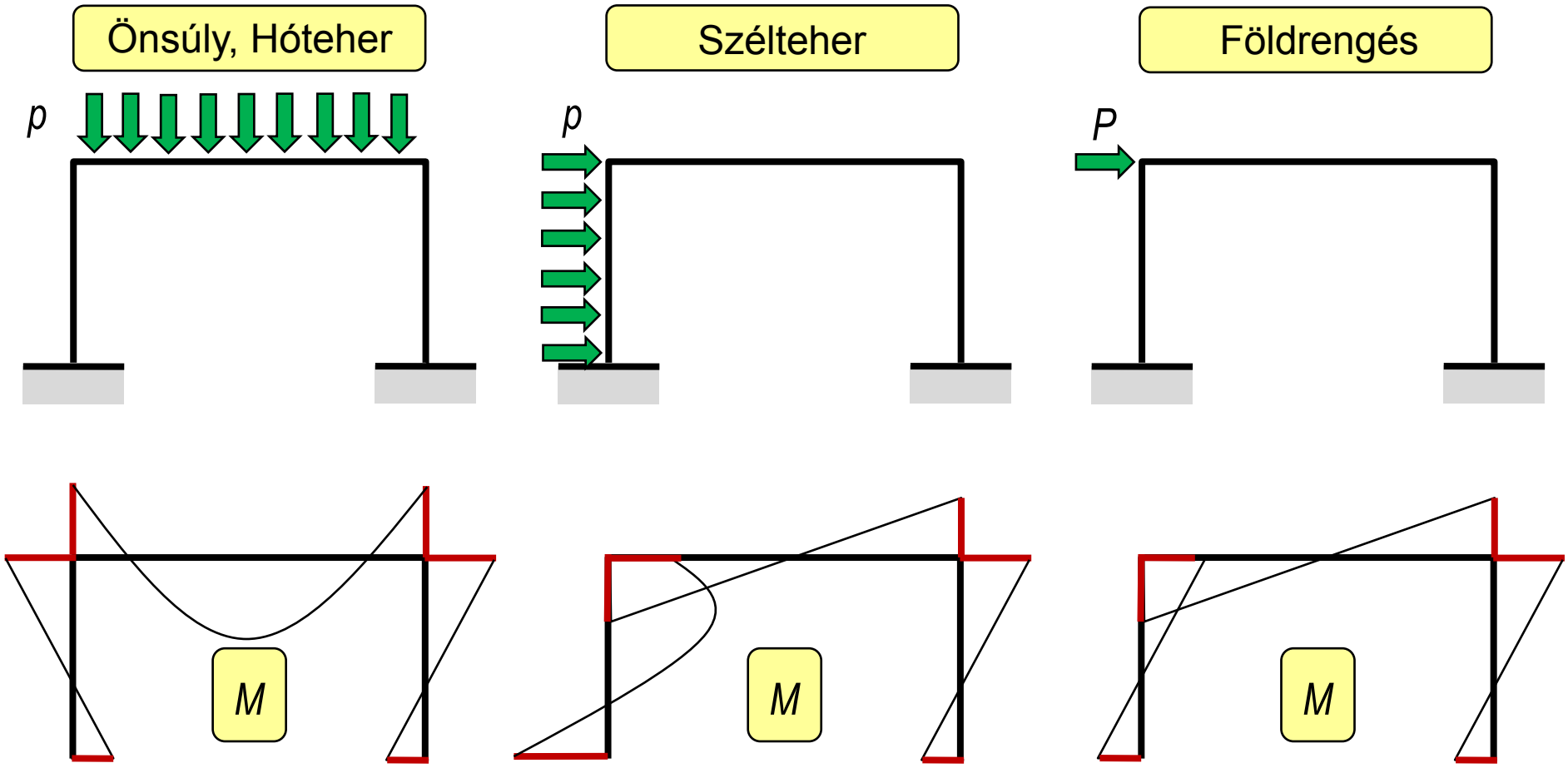
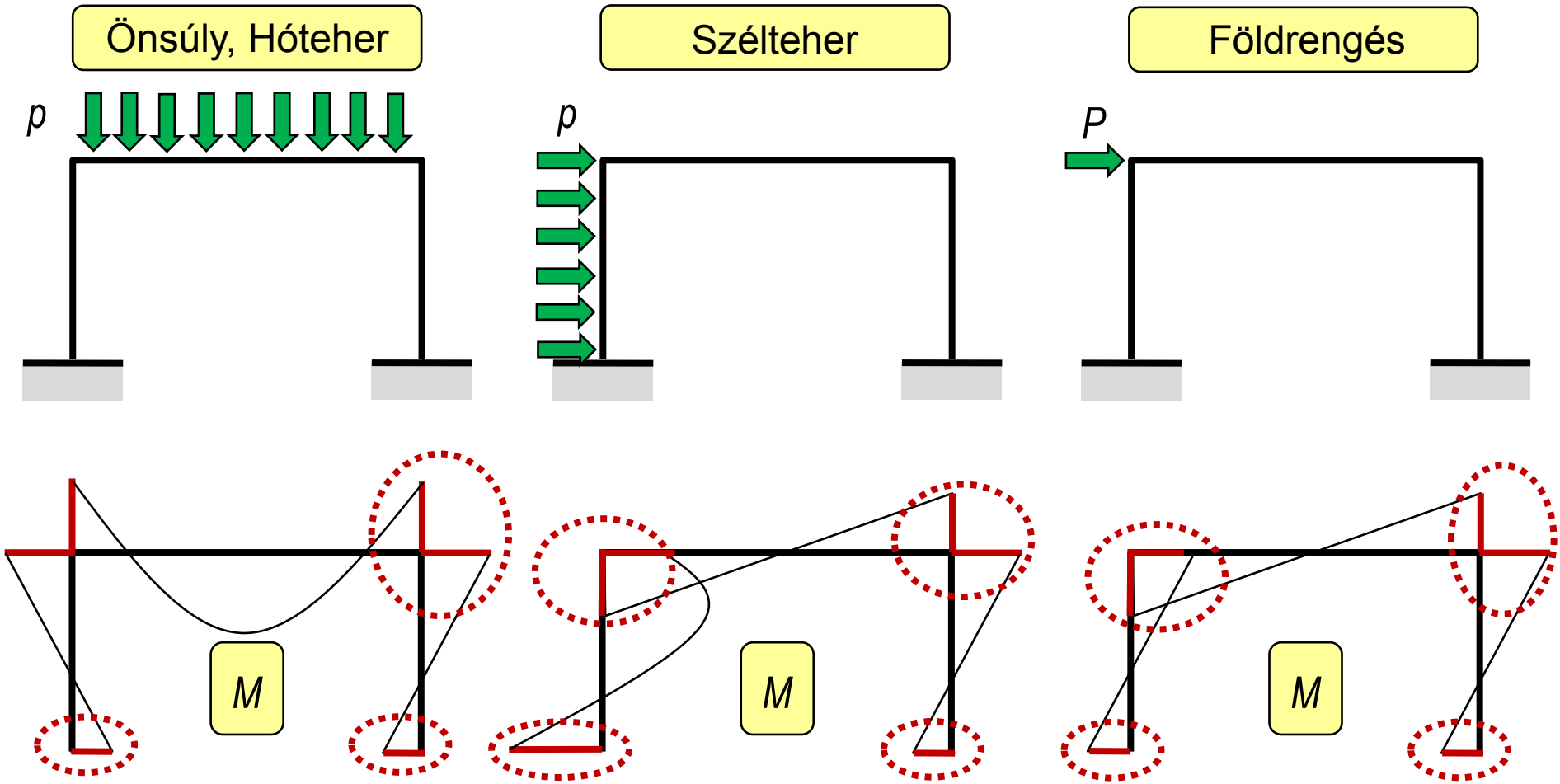


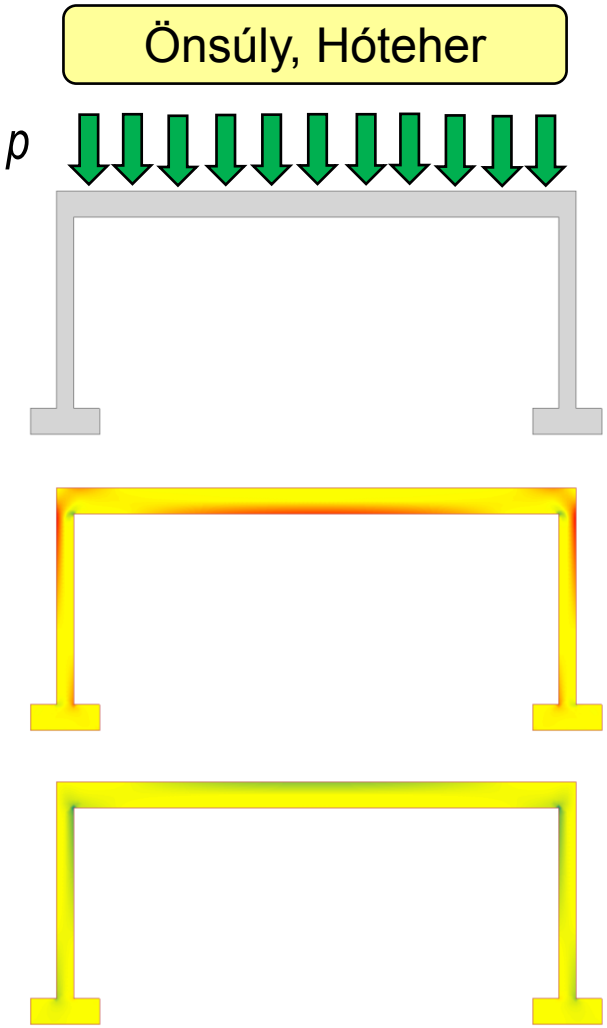
Typical actions and loads of RC frames - bending moments

Vasbeton keretek jellemző terhei és hatásai – hajlítónyomatékok



Typical tensioned and compressed zones of RC frame

Vasbeton keret jellemző húzott és nyomott zónái



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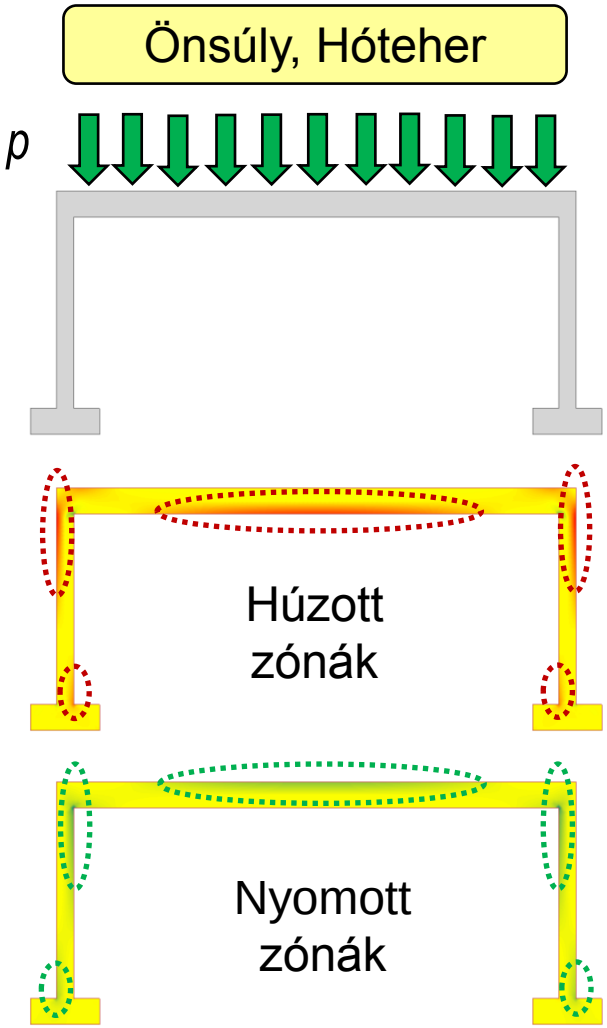
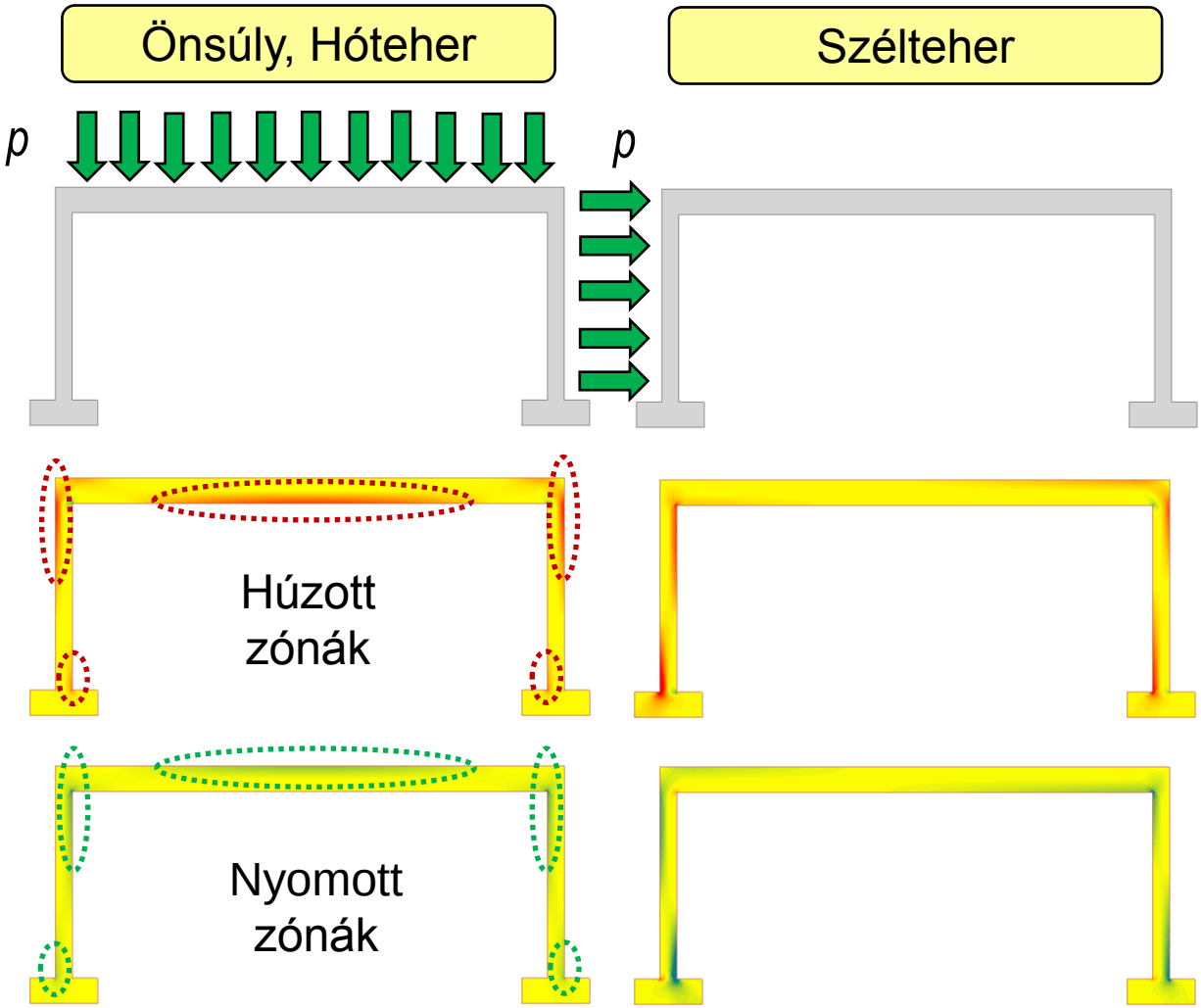


Typical tensioned and compressed zones of RC frame

Vasbeton keret jellemző húzott és nyomott zónái



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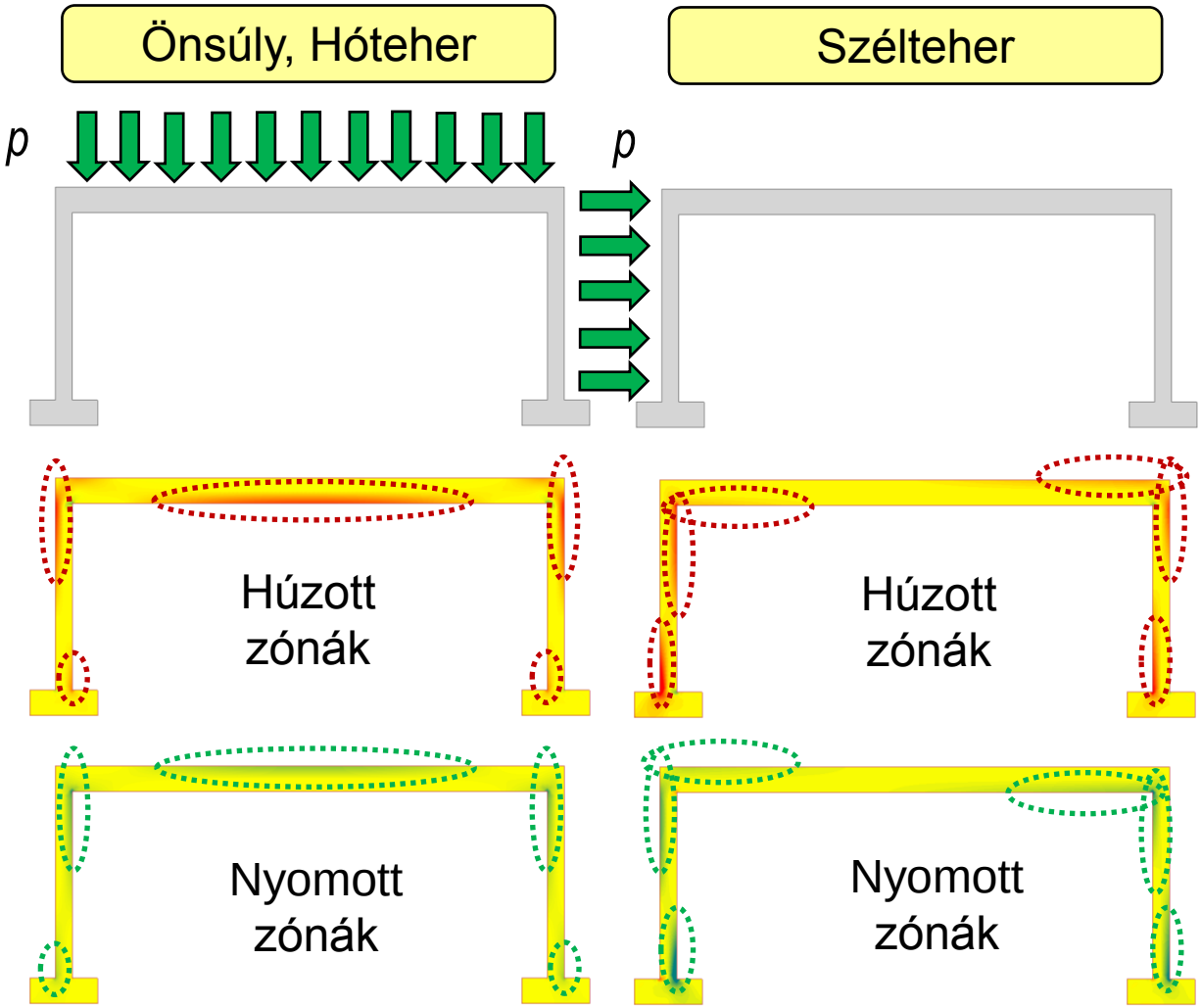
Vasbeton keret jellemző húzott és nyomott zónái



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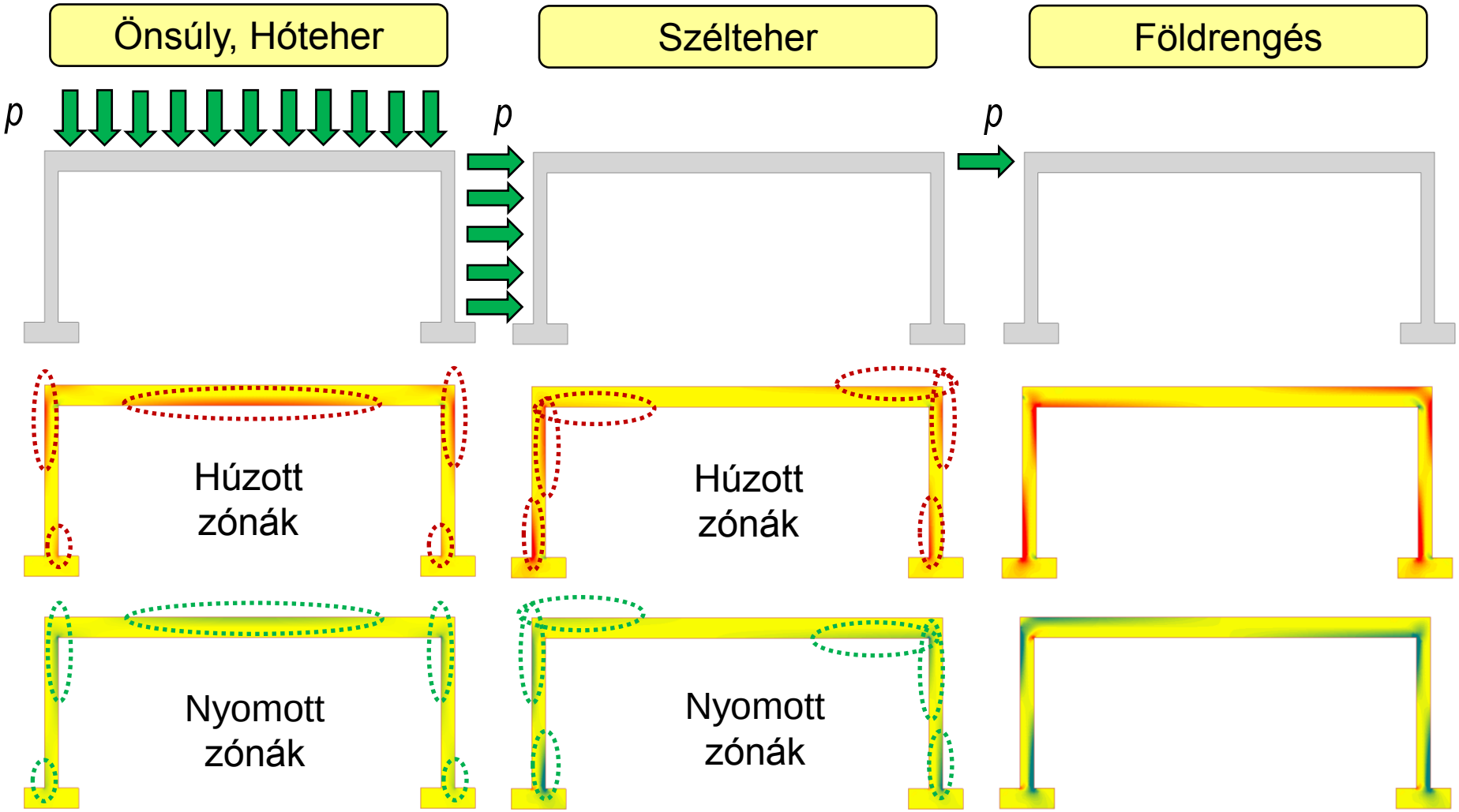
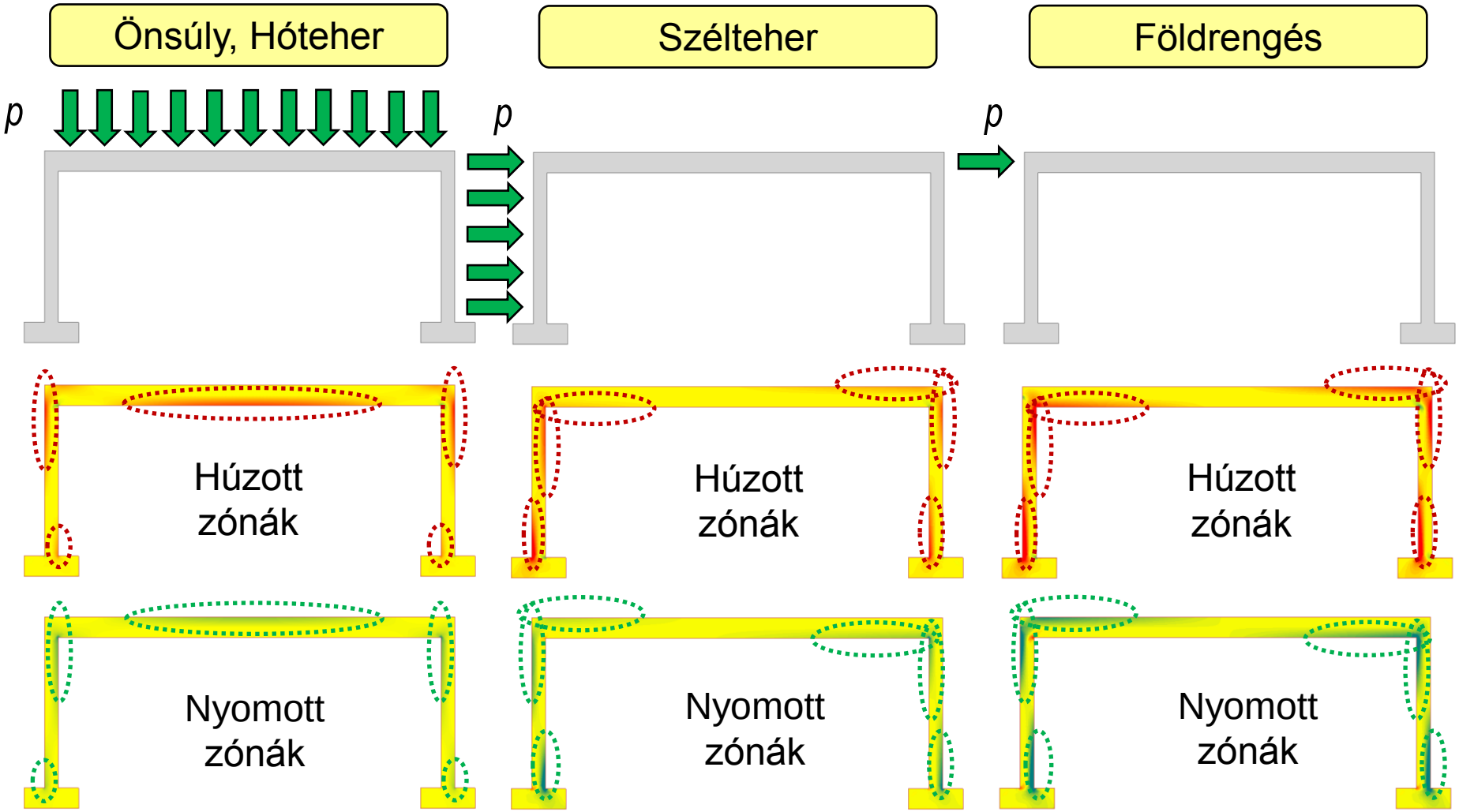
Vasbeton keret jellemző húzott és nyomott zónái



Typical tensioned and compressed zones of RC frame

Vasbeton keret jellemző húzott és nyomott zónái

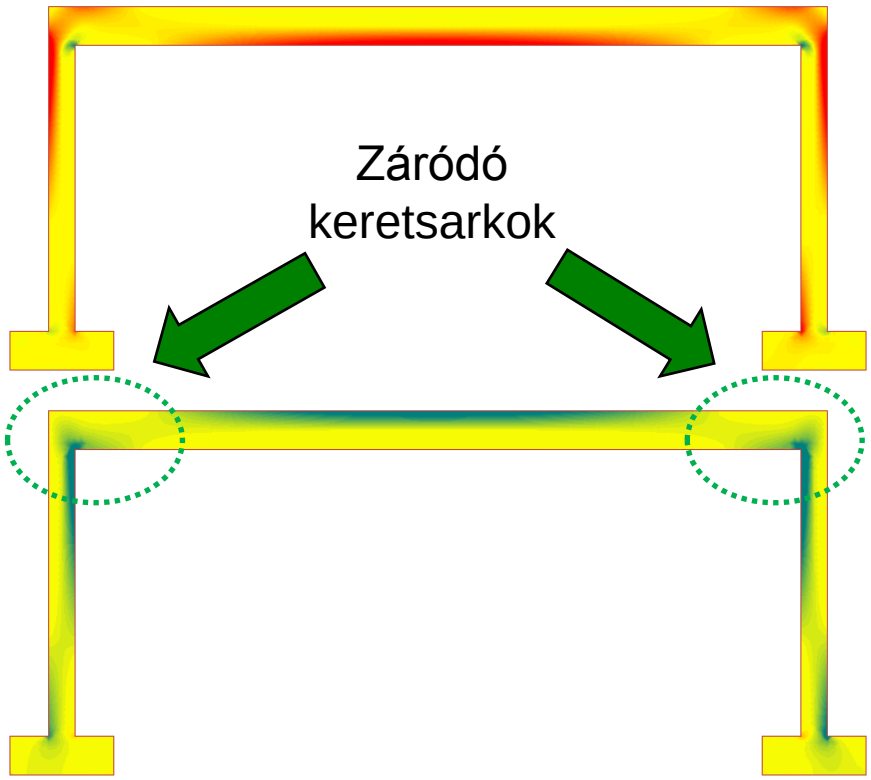


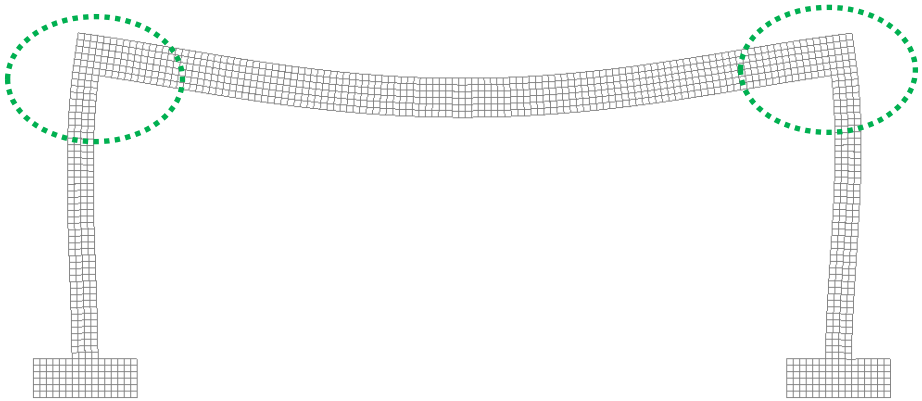
Behaviour of RC frame in the permanent design situation of the ULS

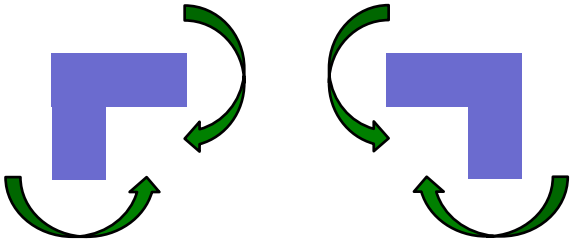
Vasbeton keret viselkedése tartós tervezési helyzetben

Tartós tervezési helyzet

$\gamma_{G,\sup} \cdot G_k$ $\gamma_{Q1} \cdot Q_{k1}$ $\gamma_{Qi} \cdot \psi_{0i} \cdot Q_{ki}$





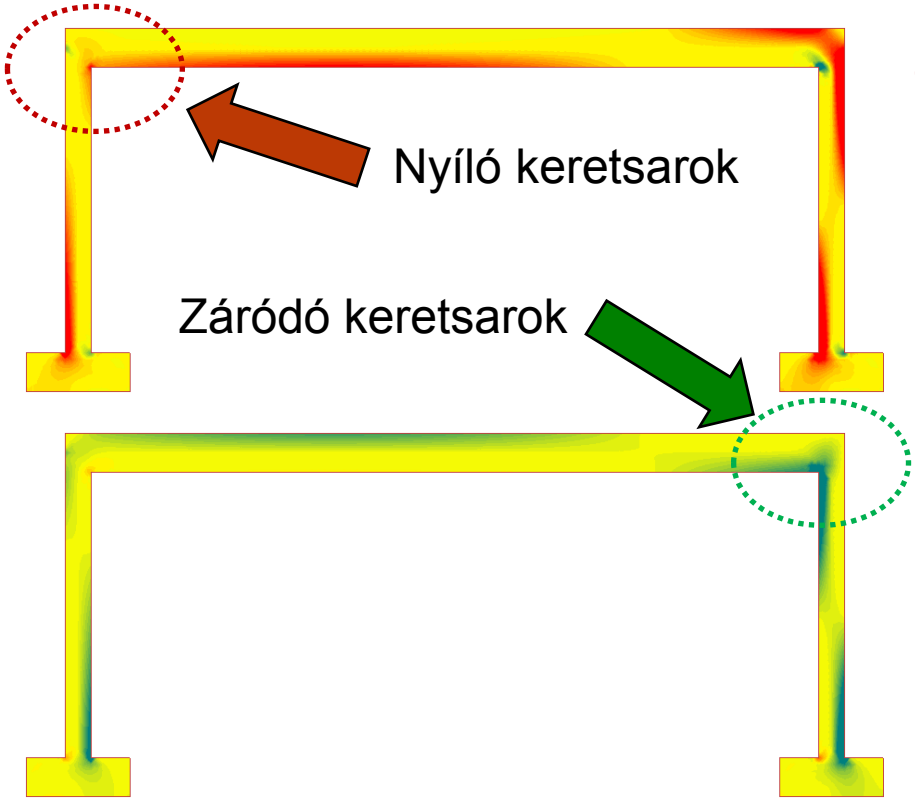


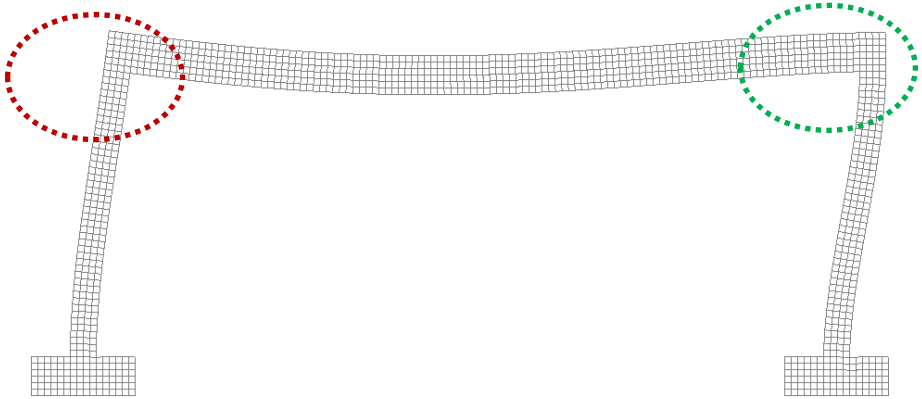
Behaviour of RC frame in the seismic design situation of the ULS

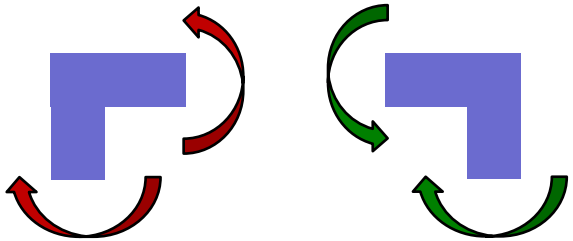
Vasbeton keret viselkedése szeizmikus tervezési helyzetben

Szeizmikus tervezési helyzet

G_k $\psi_{2i} \cdot Q_{ki}$ A_{Ed}

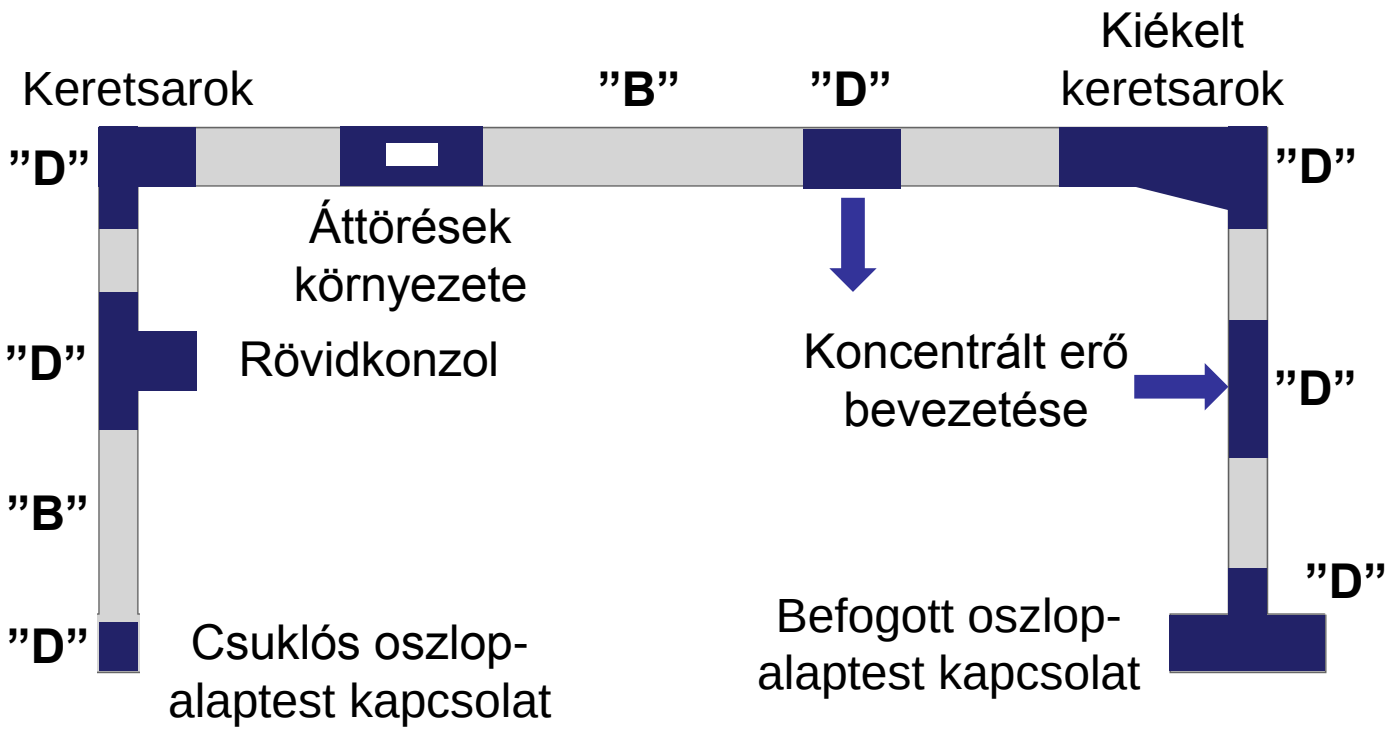






B (beam) and D (disturbed) region of RC frames

Vasbeton keretek zavart (D) és nem zavart (B) régiói

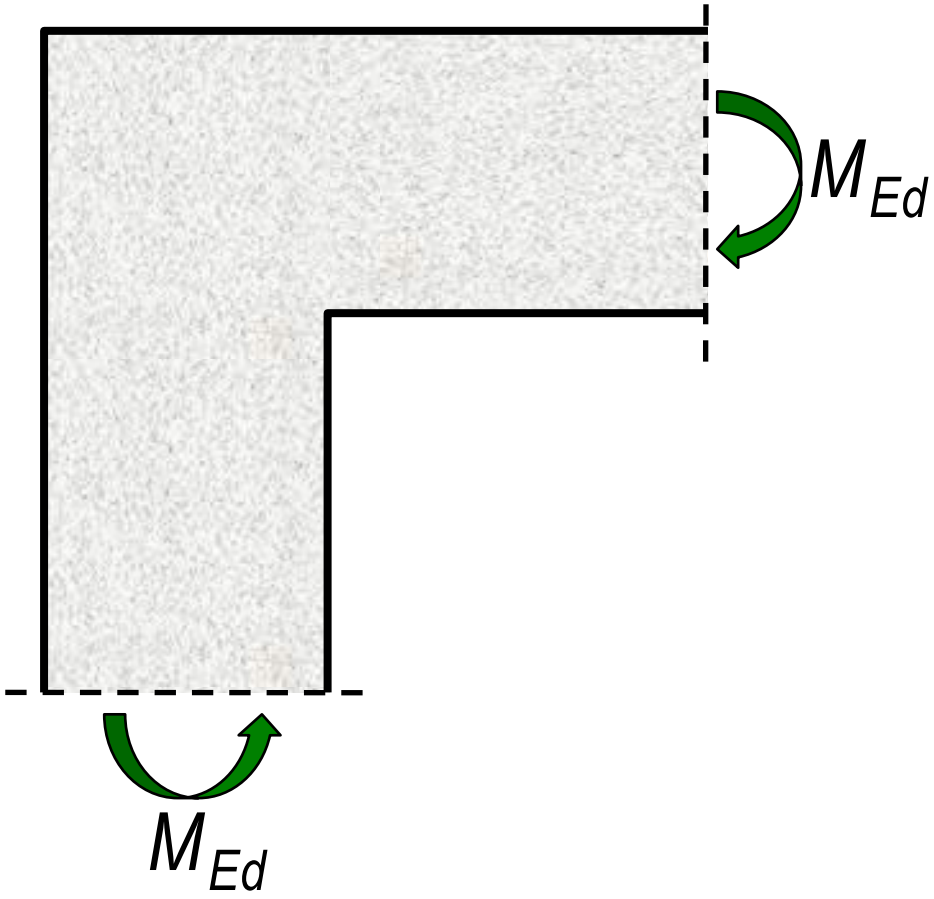


RC frame corner

Vasbeton keretsarok

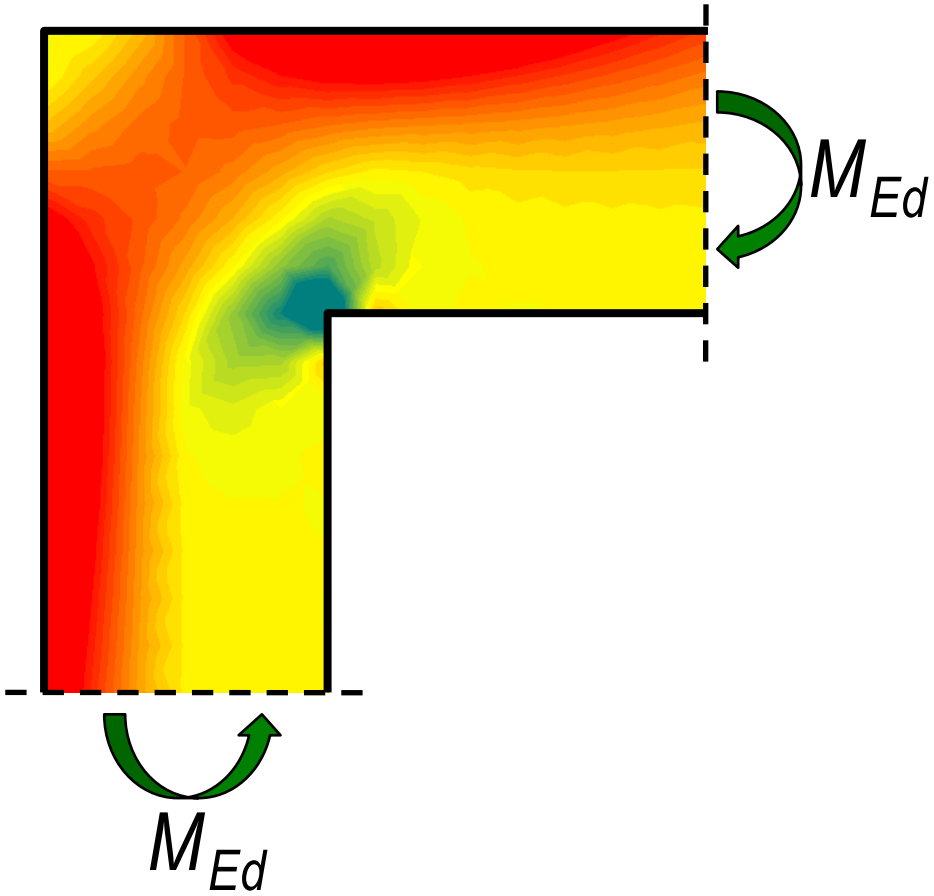
Closing RC frame corner

Záródó vasbeton keretsarok



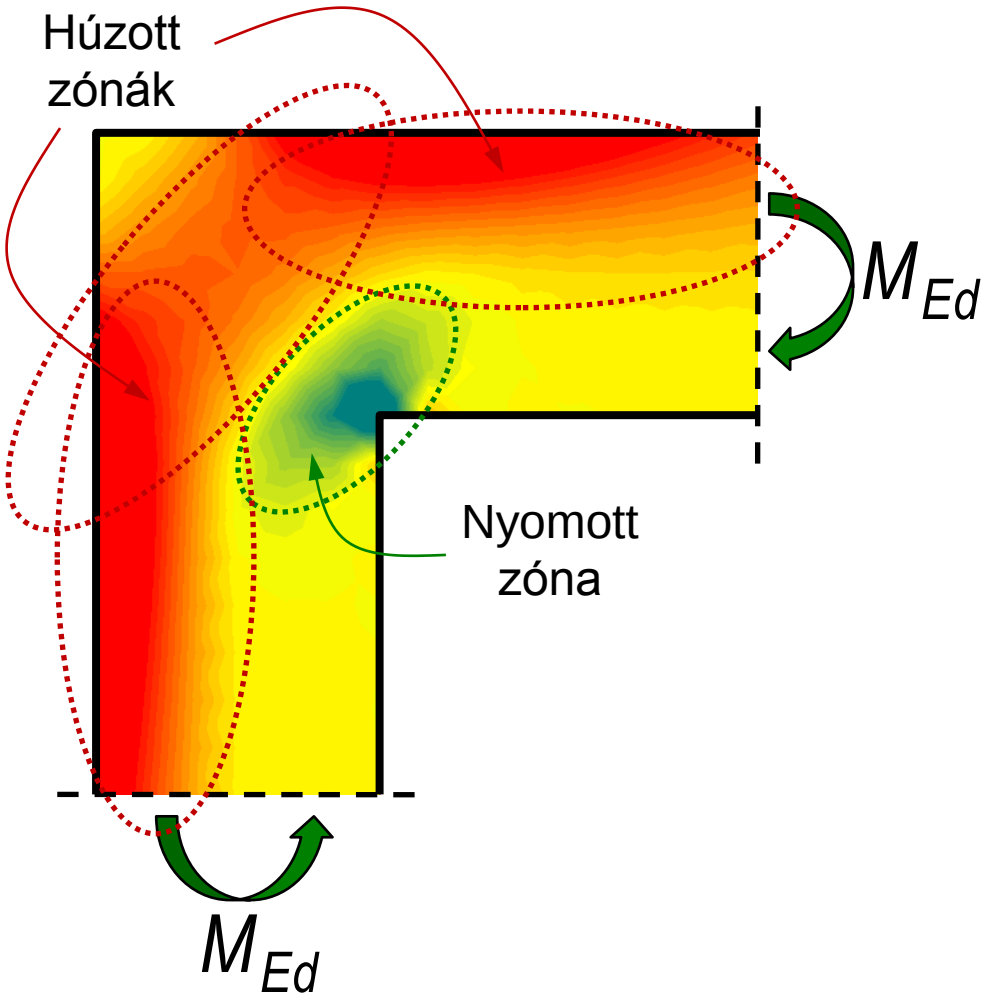
Main stresses of a closing RC frame corner

Záródó vasbeton keretsarok főfeszültségei



Tensioned and compressed zones of a closing RC frame corner

Záródó vasbeton keretsarok húzott és nyomott zónái



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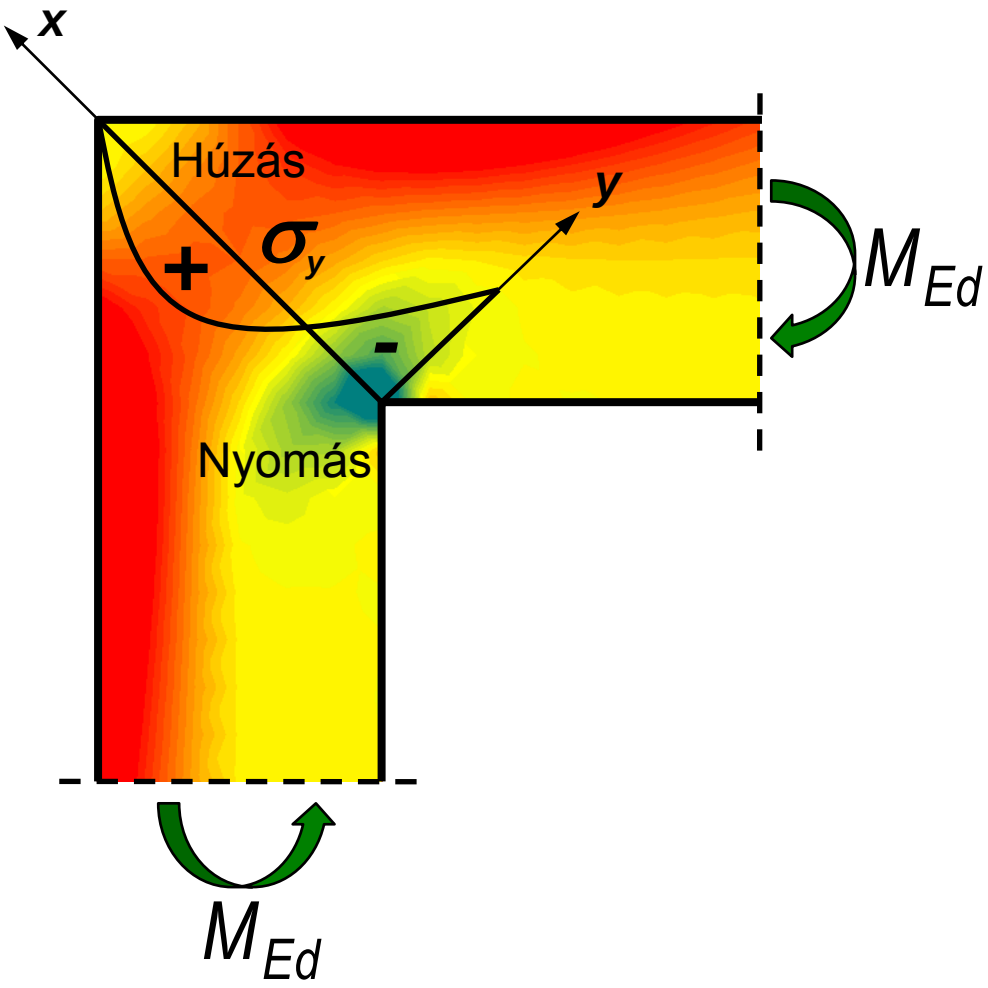
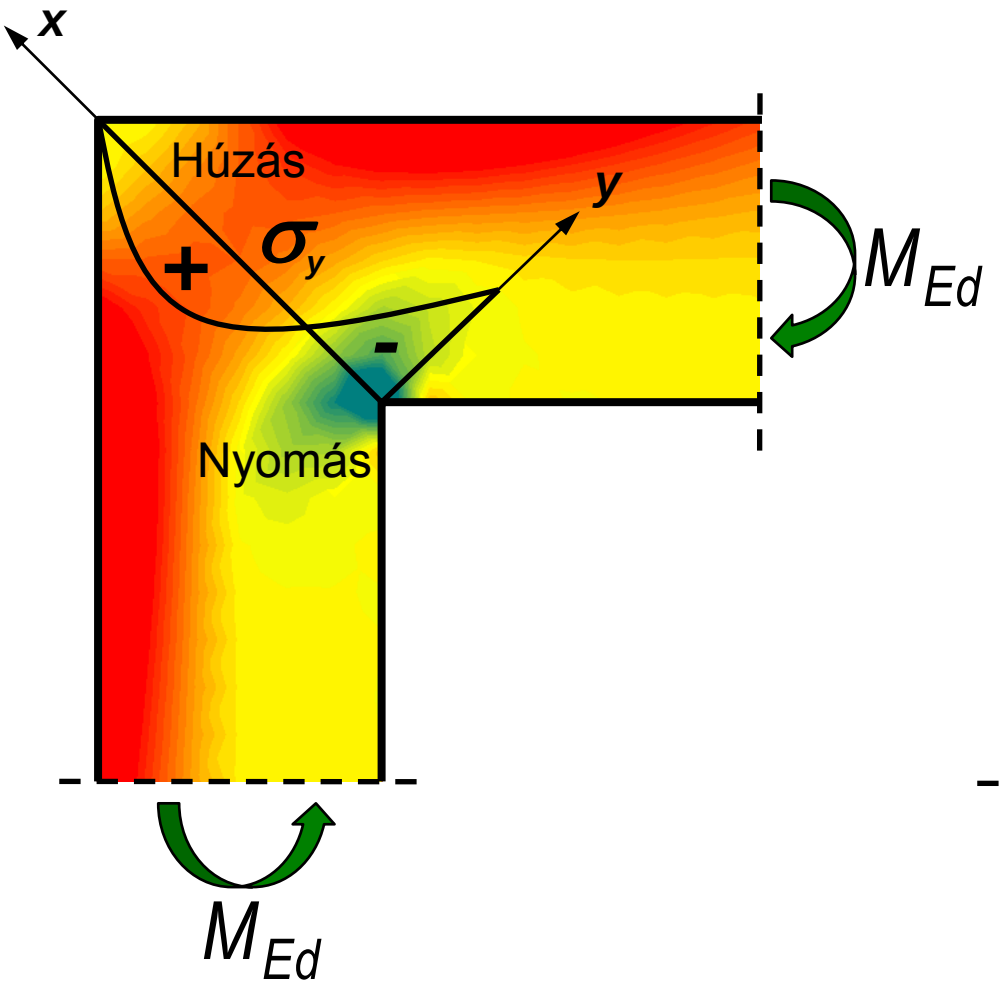
Tensioned and compressed zones of a closing RC frame corner

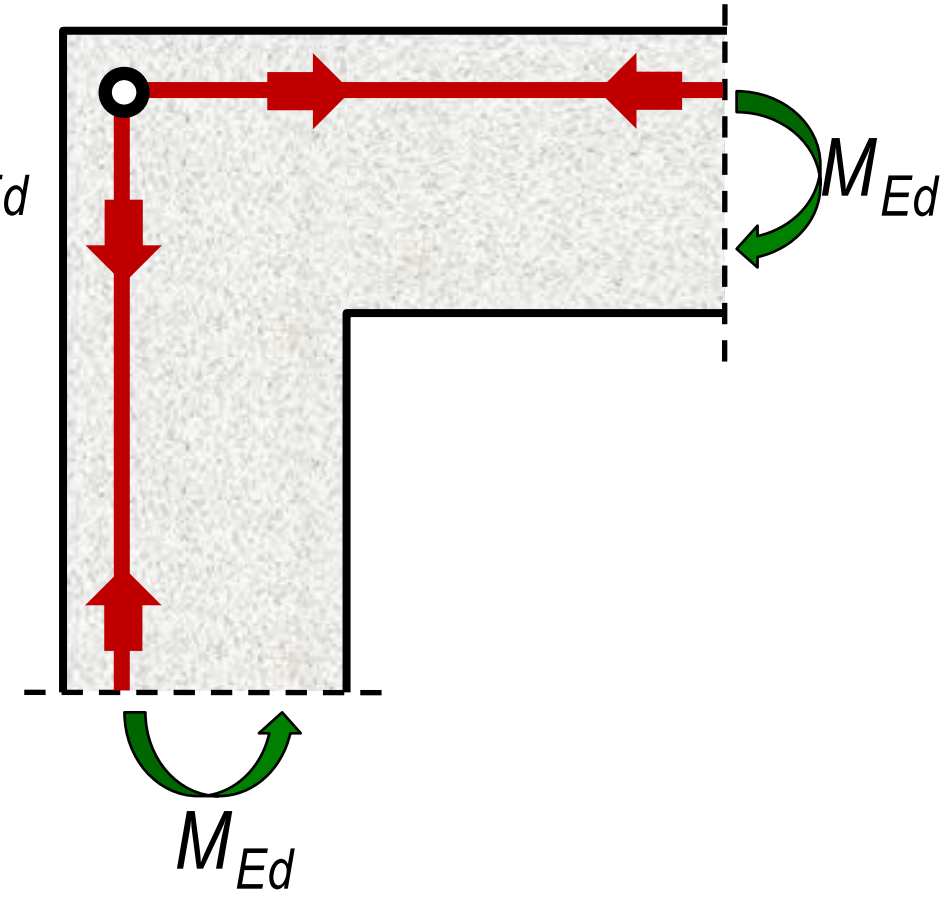
Záródó vasbeton keretsarok húzott és nyomott zónái



Force flow of a closing RC frame corner

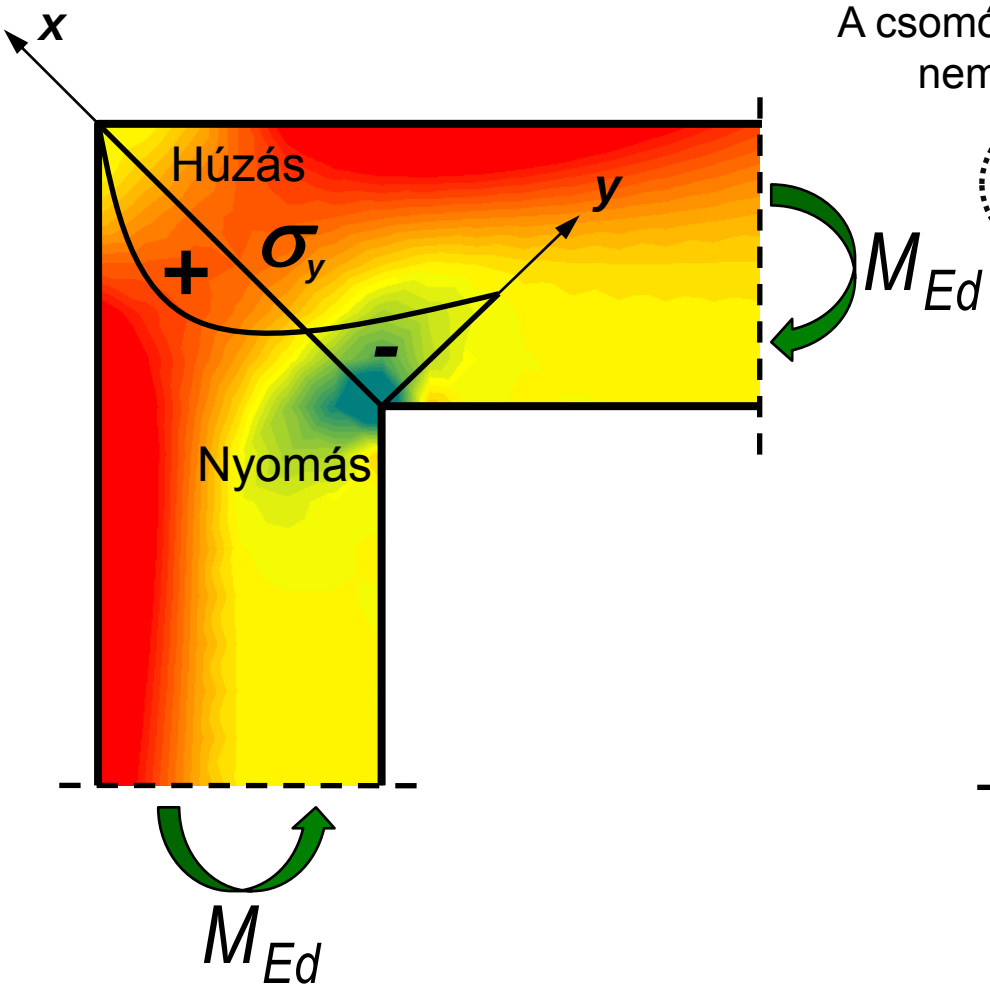
Záródó vasbeton keretsarok erőjátéka



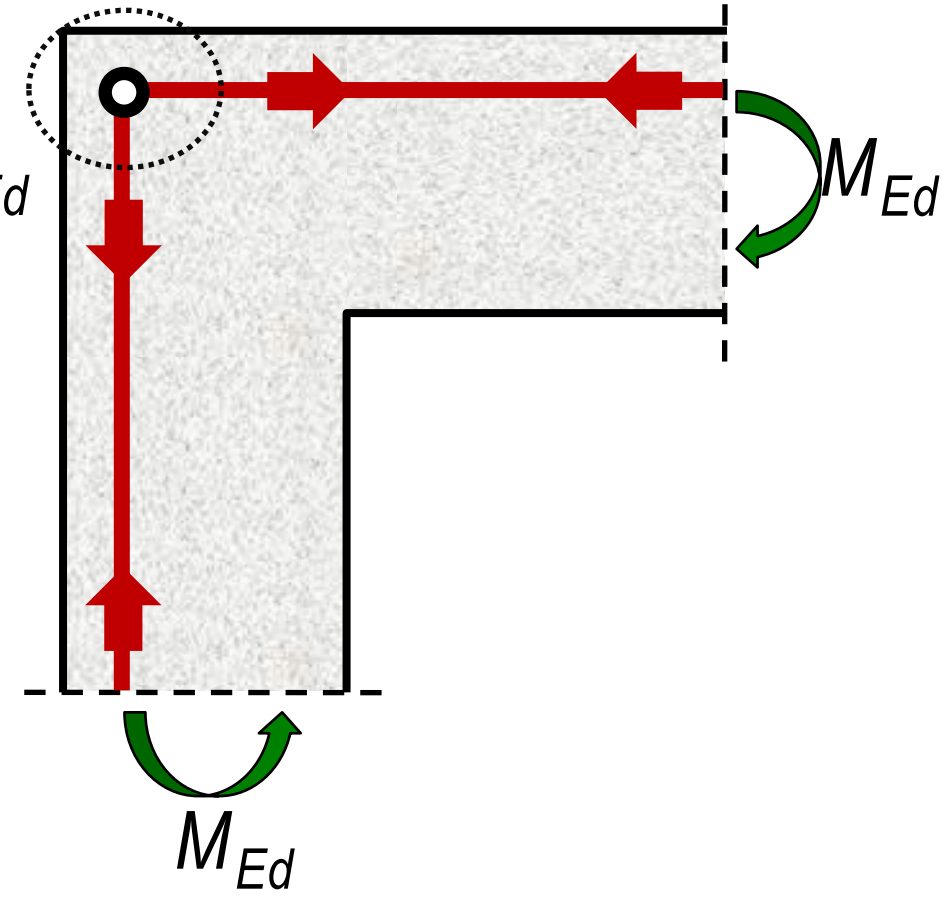


Force flow of a closing RC frame corner

Záródó vasbeton keretsarok erőjátéka



A csomópont egyensúlya nem biztosított!!!



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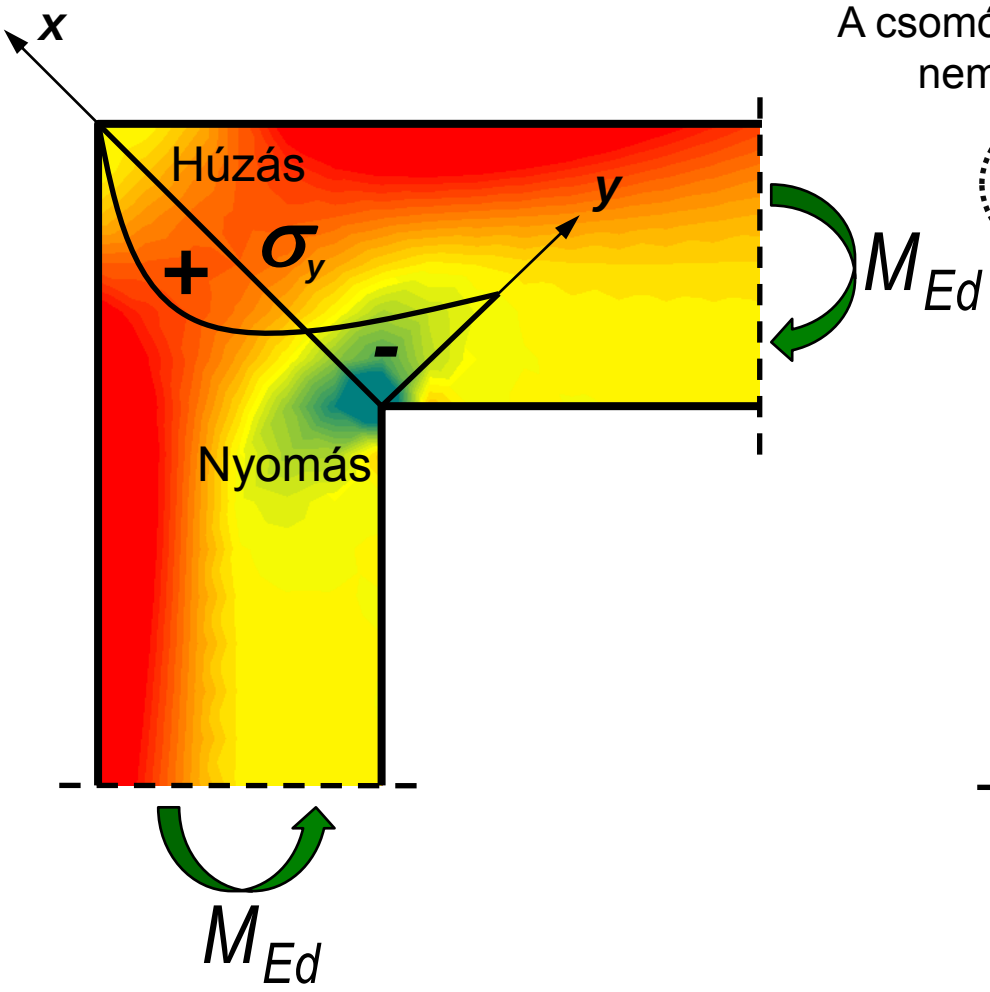
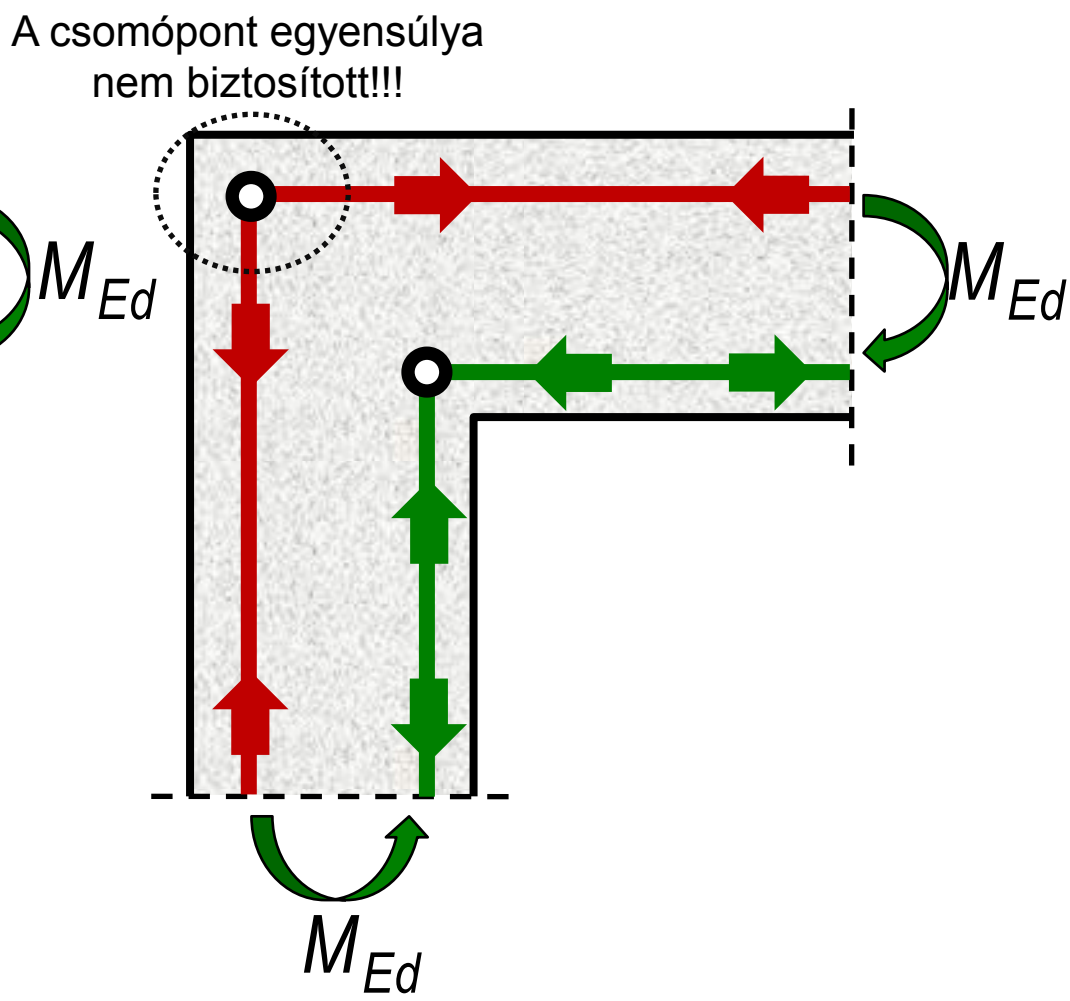
Force flow of a closing RC frame corner

Záródó vasbeton keretsarok erőjátéka





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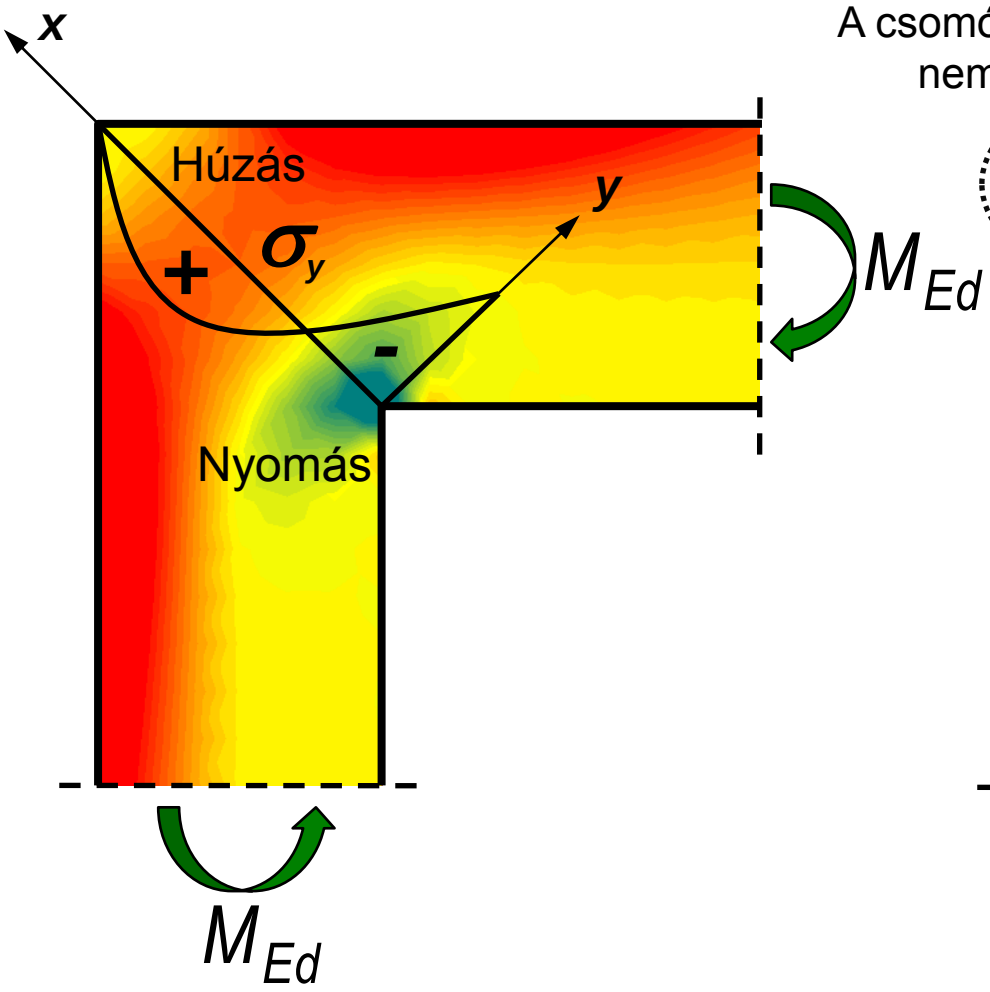
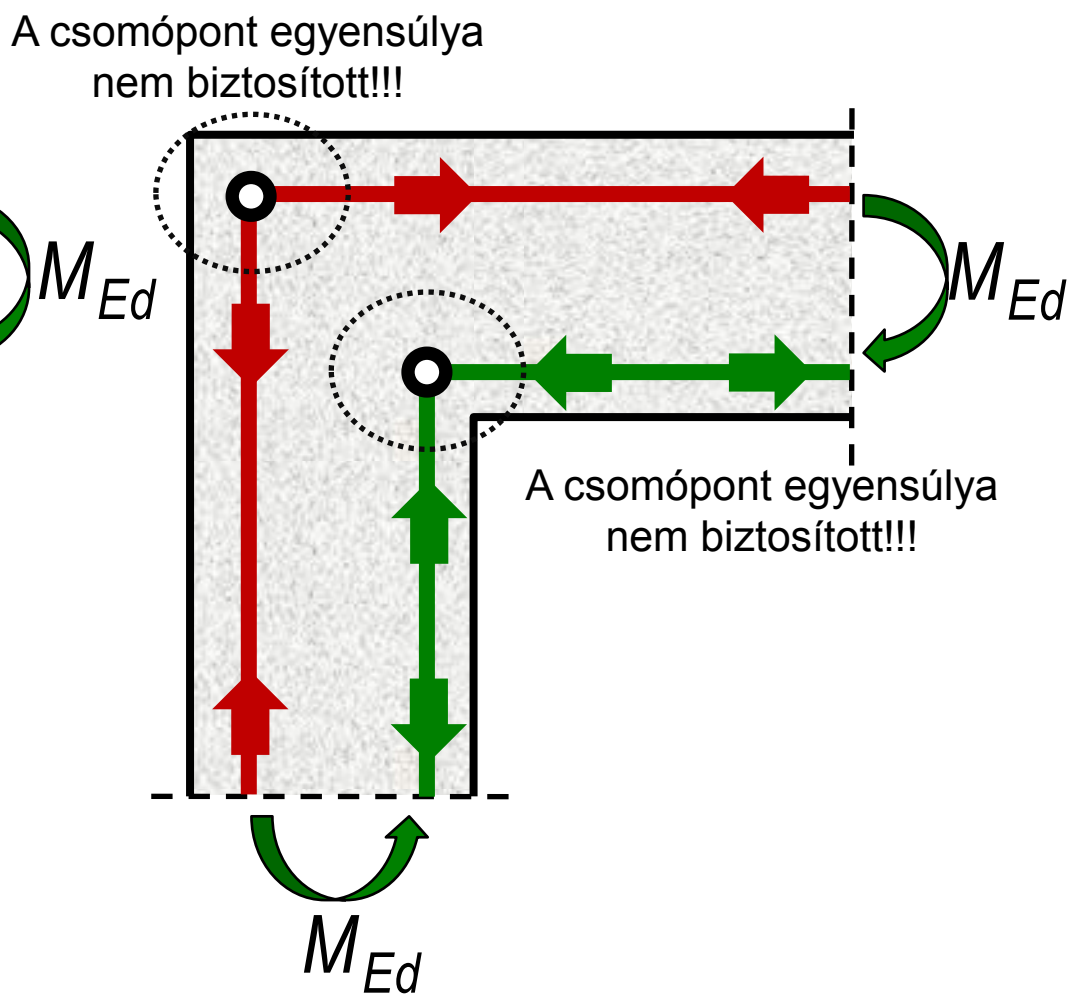
Force flow of a closing RC frame corner

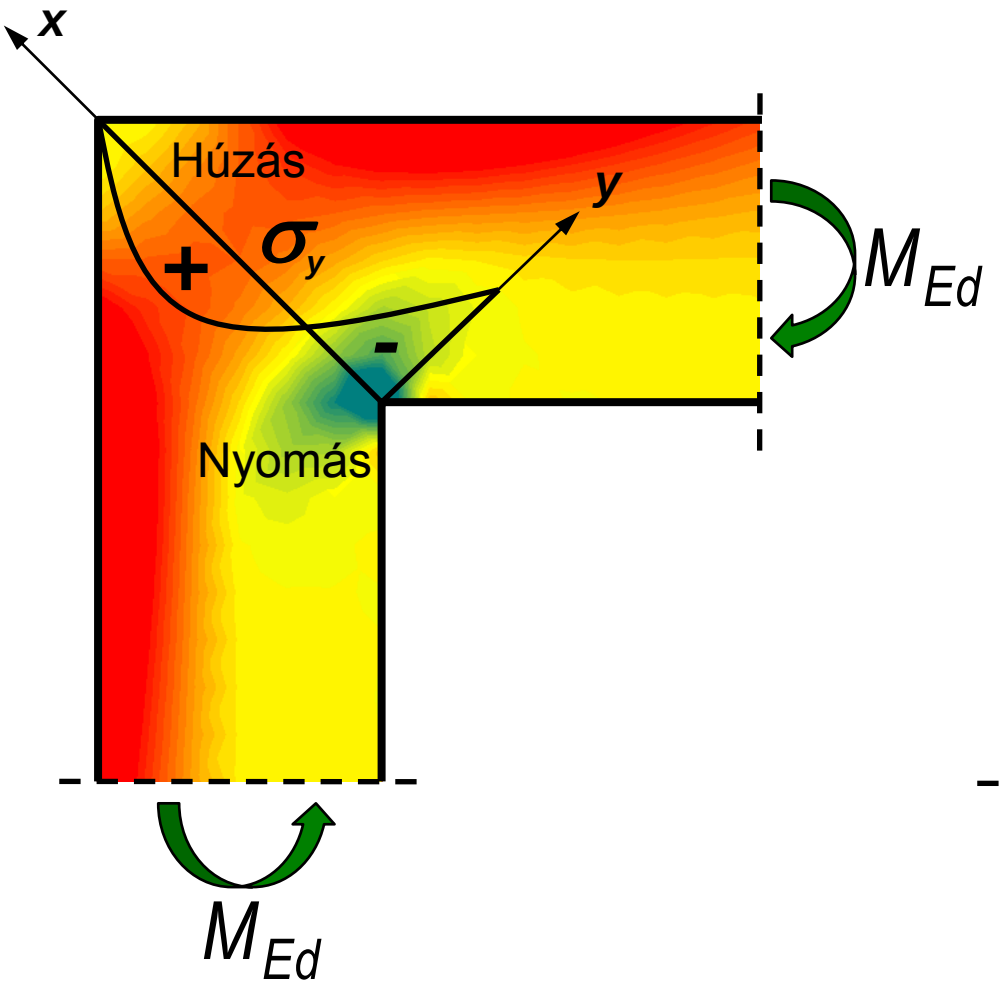
Záródó vasbeton keretsarok erőjátéka

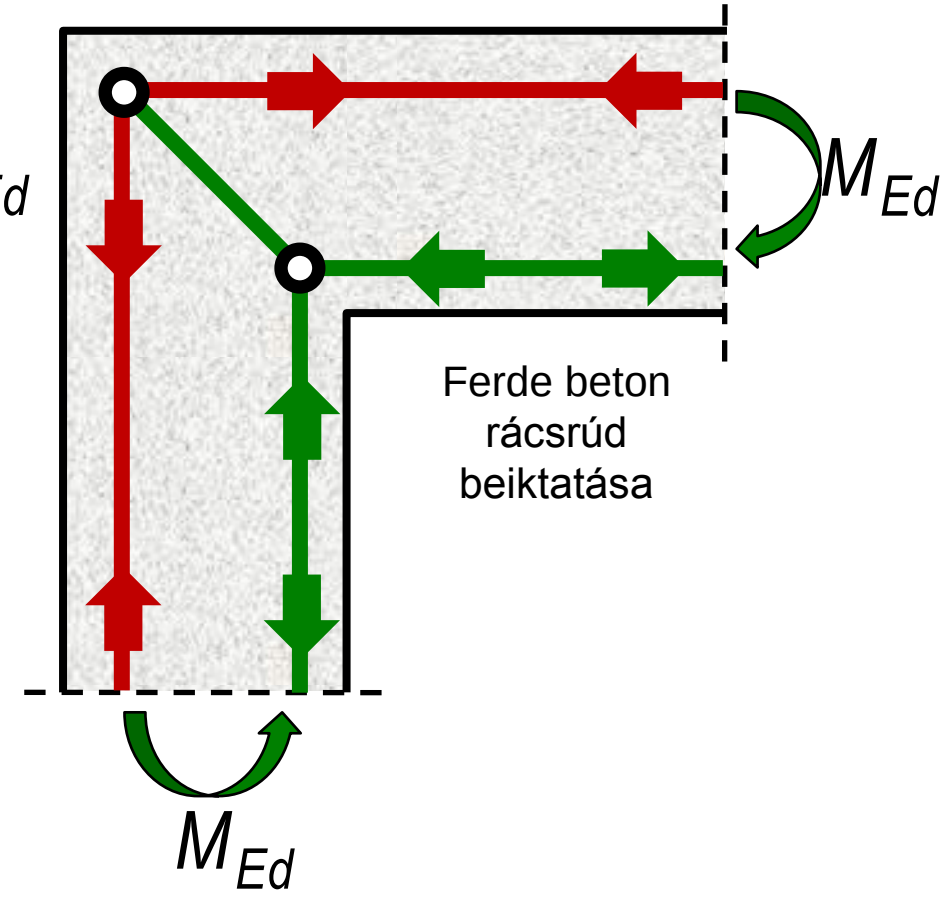




Force flow of a closing RC frame corner

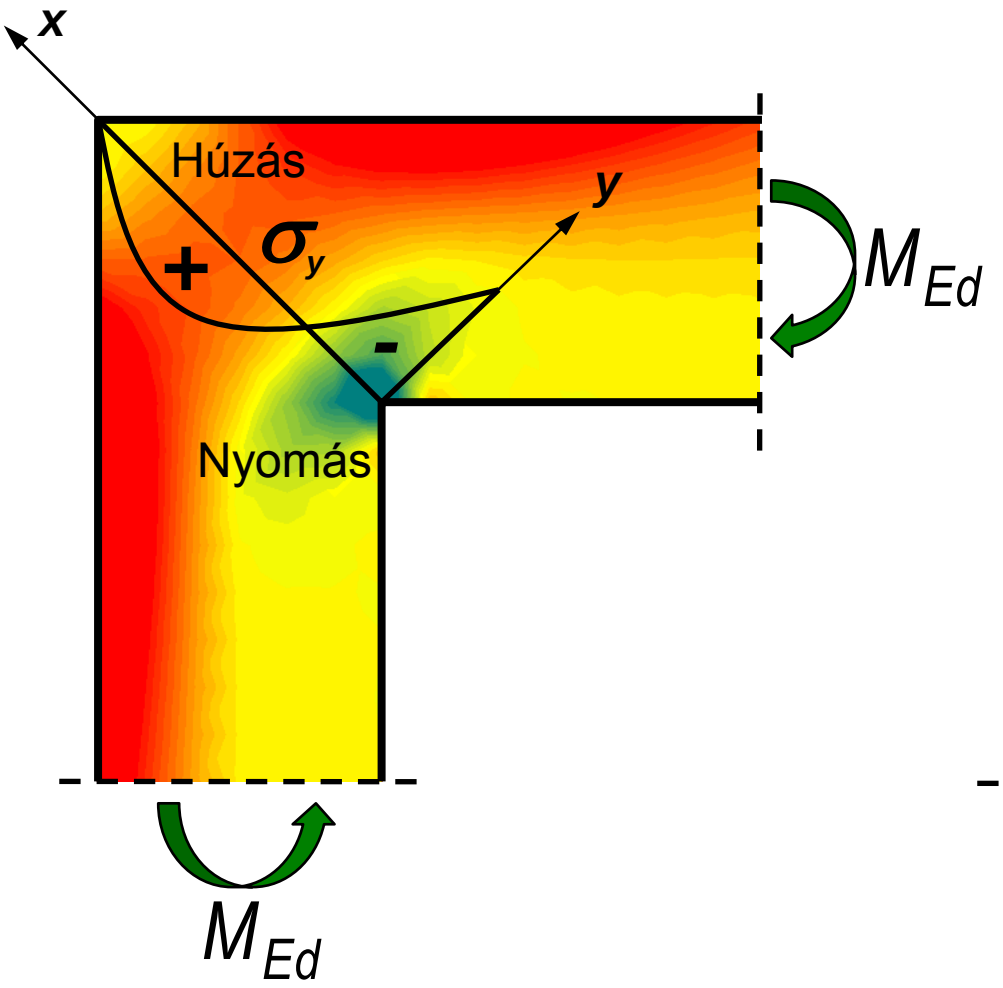
Záródó vasbeton keretsarok erőjátéka

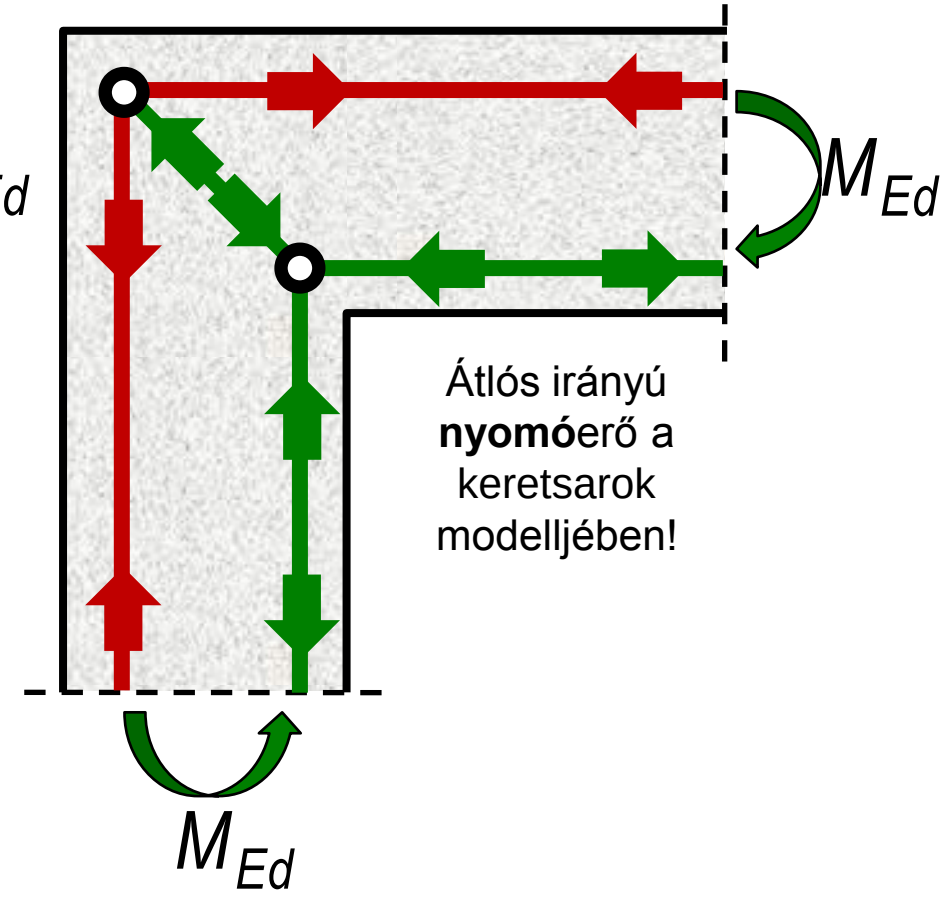




Force flow of a closing RC frame corner

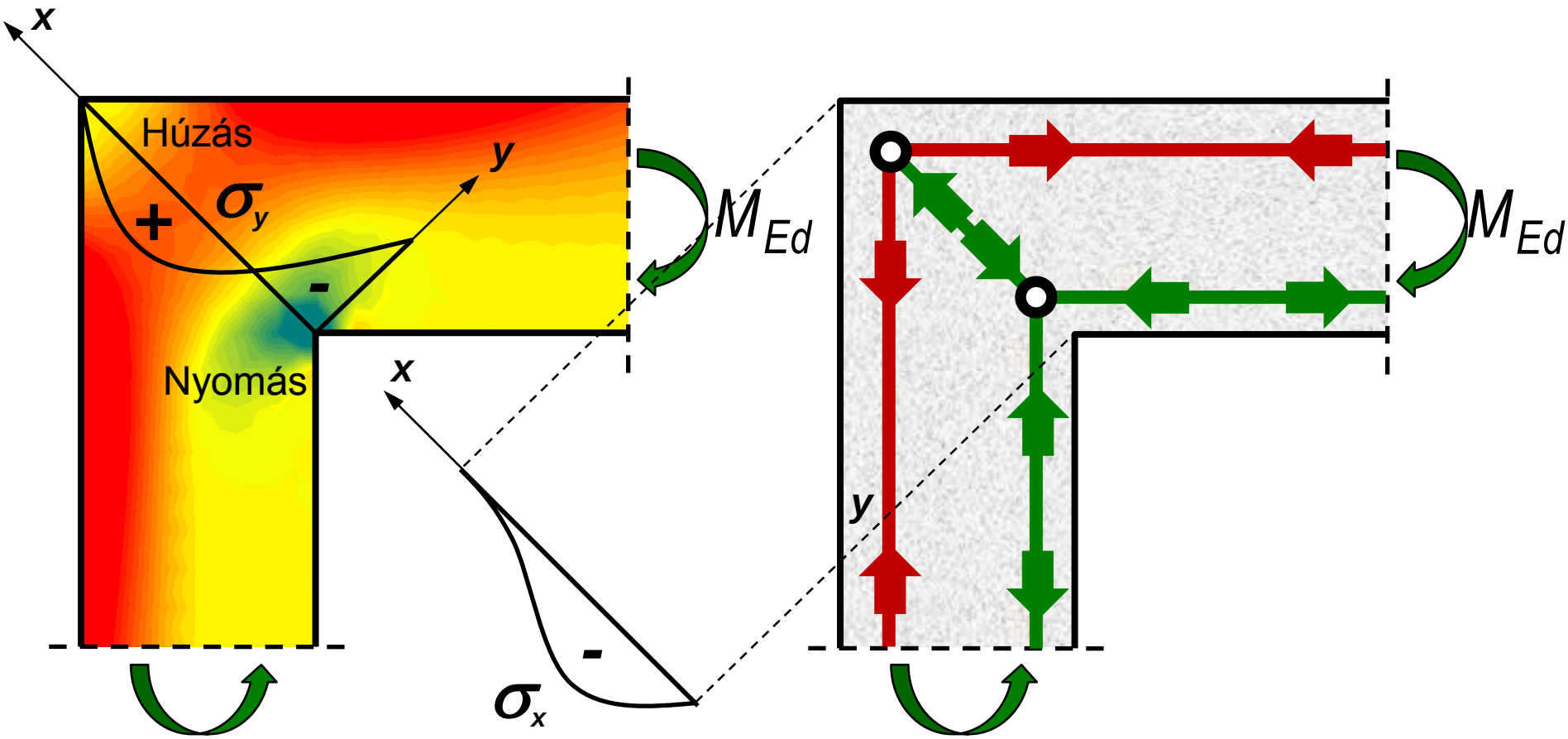
Záródó vasbeton keretsarok erőjátéka





Force flow of a closing RC frame corner

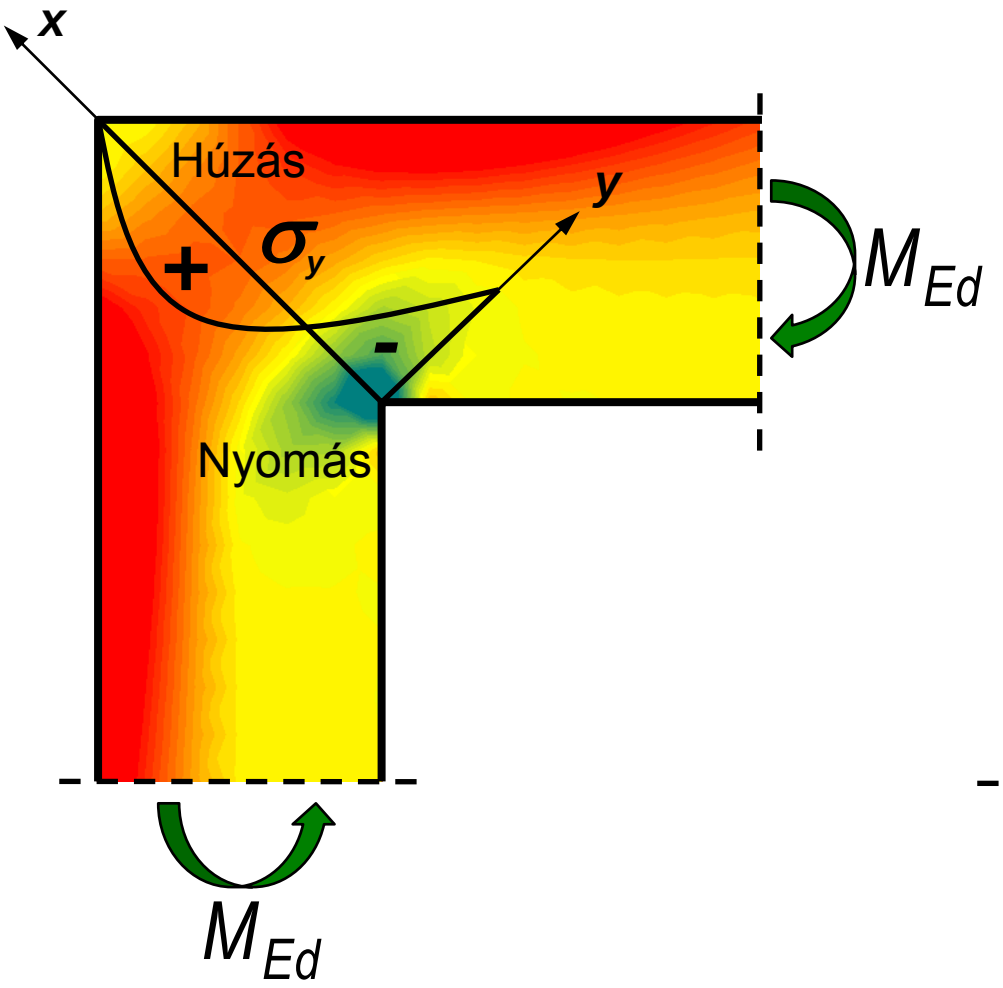
Záródó vasbeton keretsarok erőjátéka

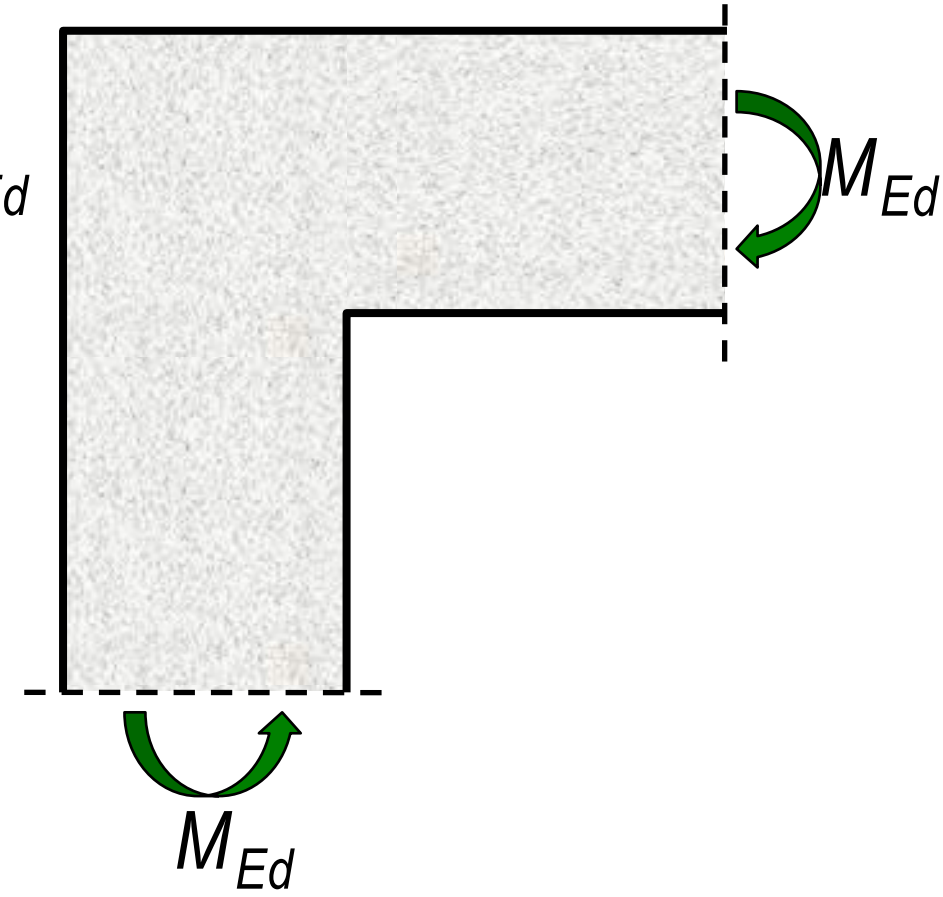


Átlós irányú **nyomó**feszültségek eloszlása a keretsarokban

Reinforcing detail of a closing RC frame corner

Záródó vasbeton keretsarok vasvezetése





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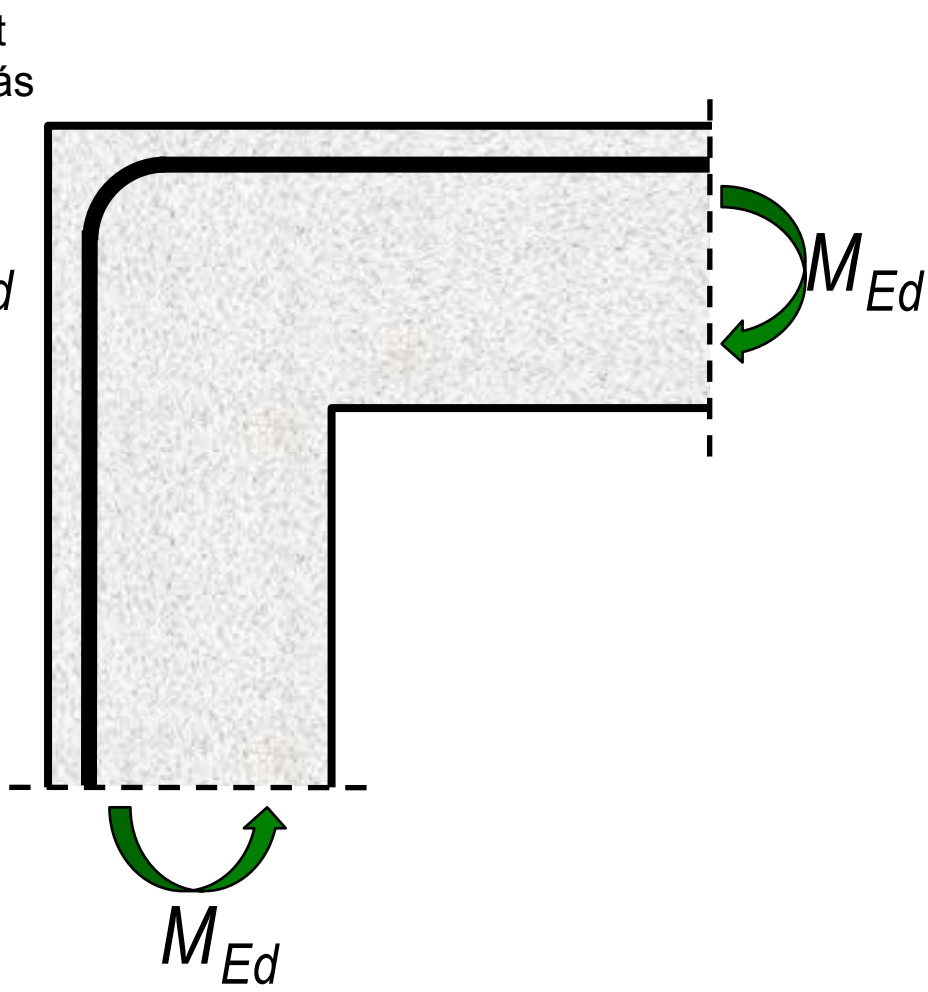
Reinforcing detail of a closing RC frame corner

Záródó vasbeton keretsarok vasvezetése



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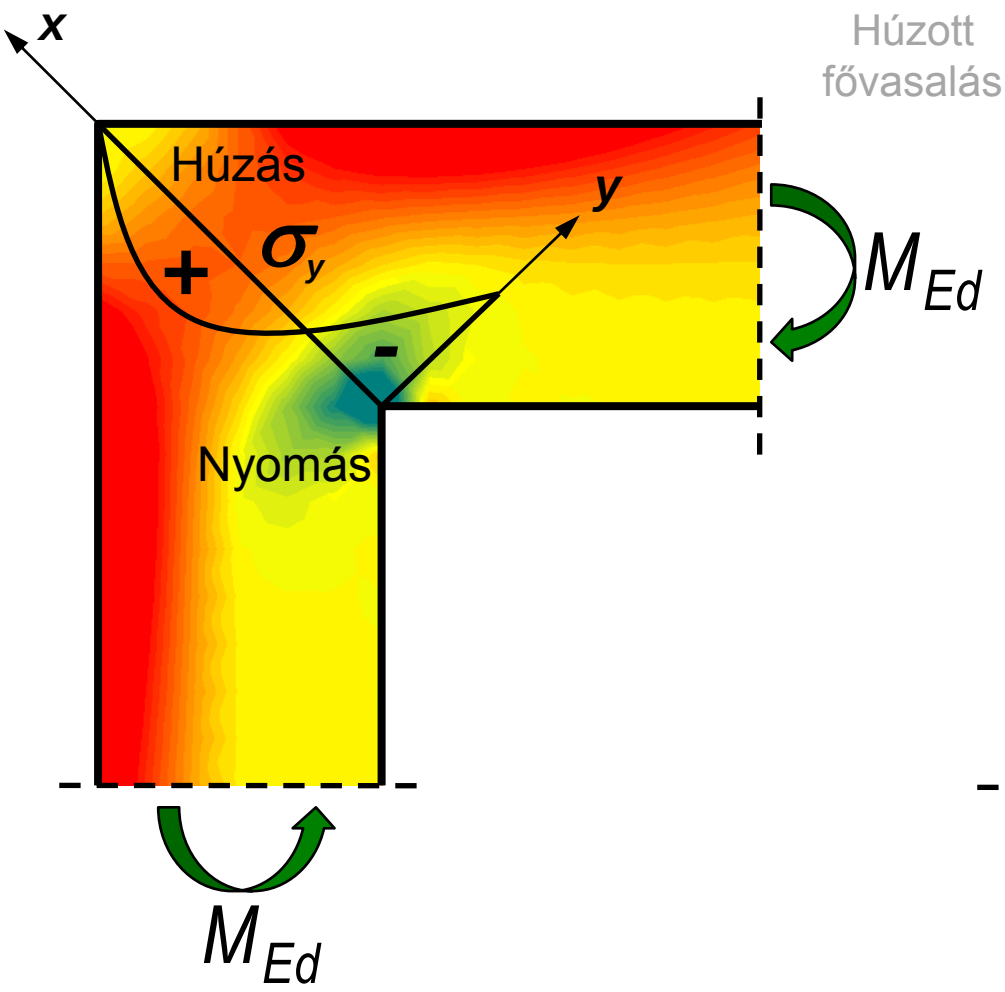

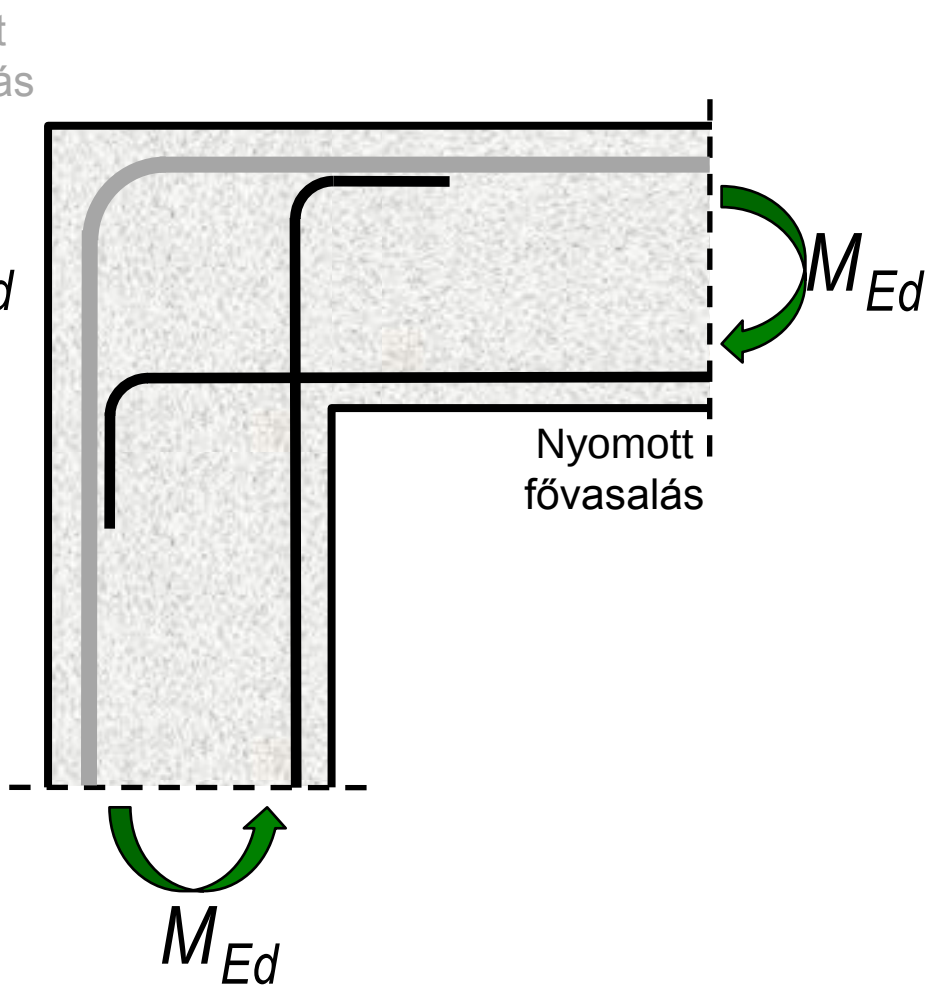

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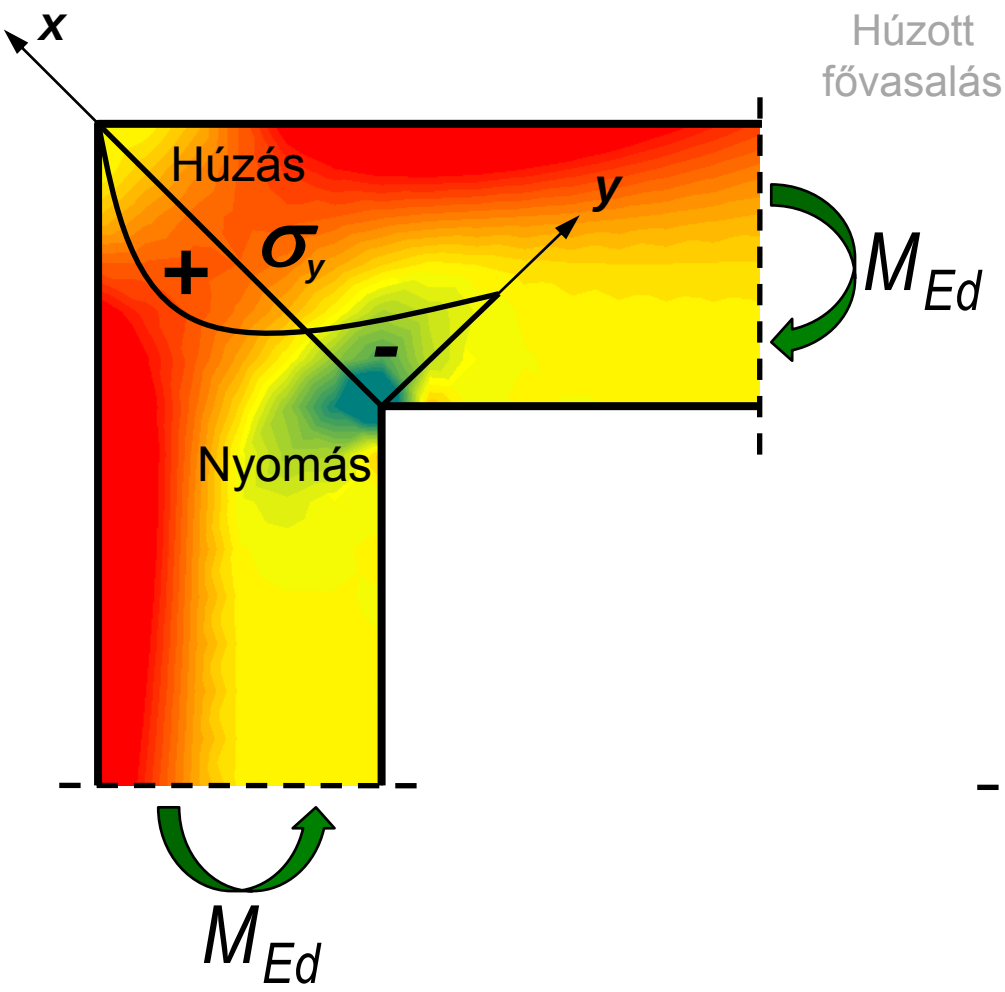
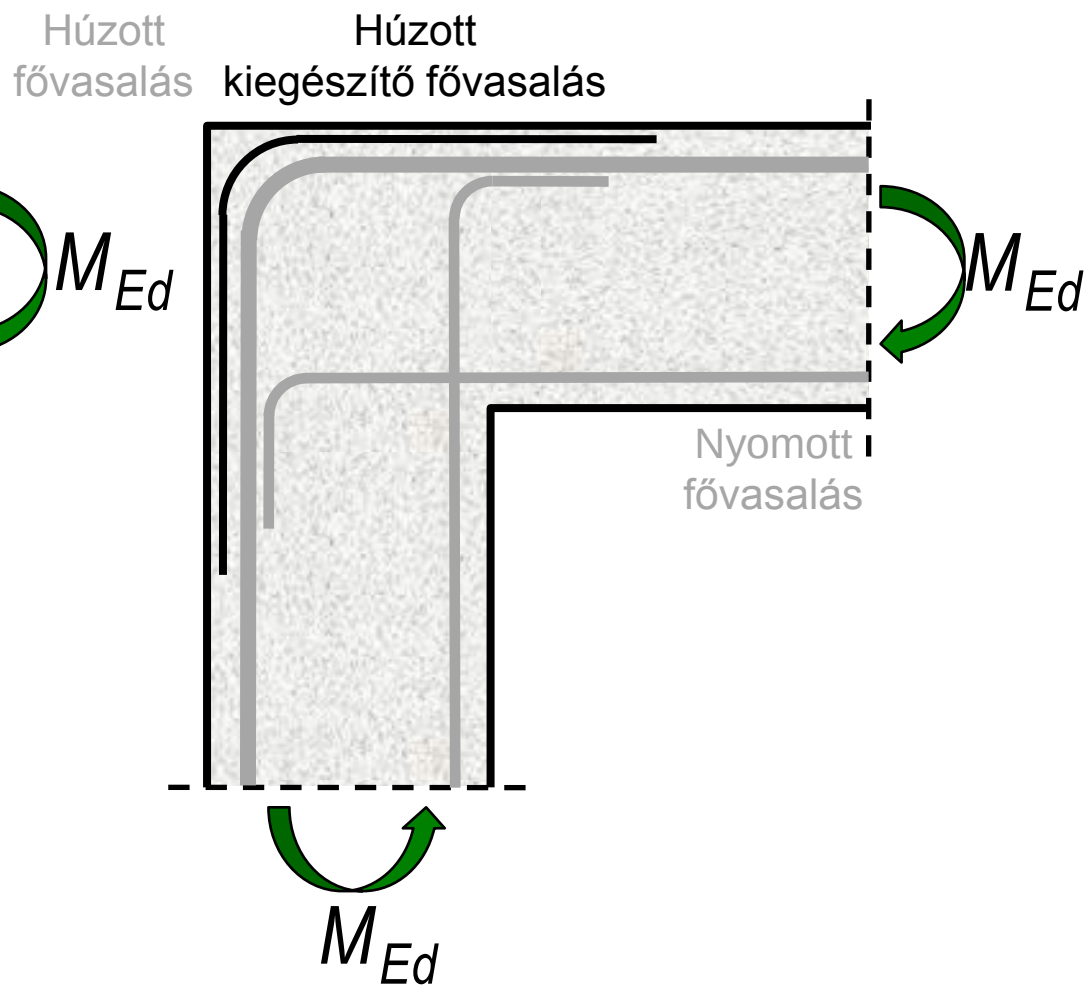
Záródó vasbeton keretsarok vasvezetése





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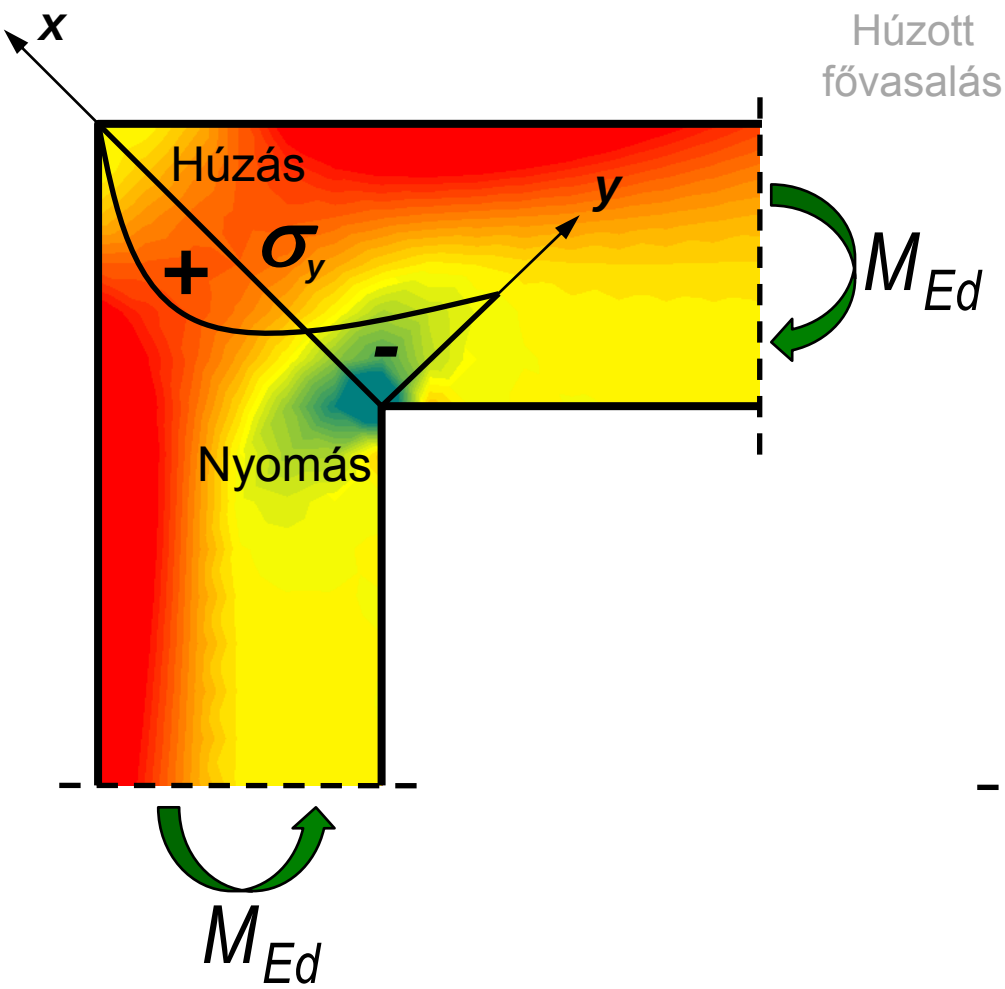
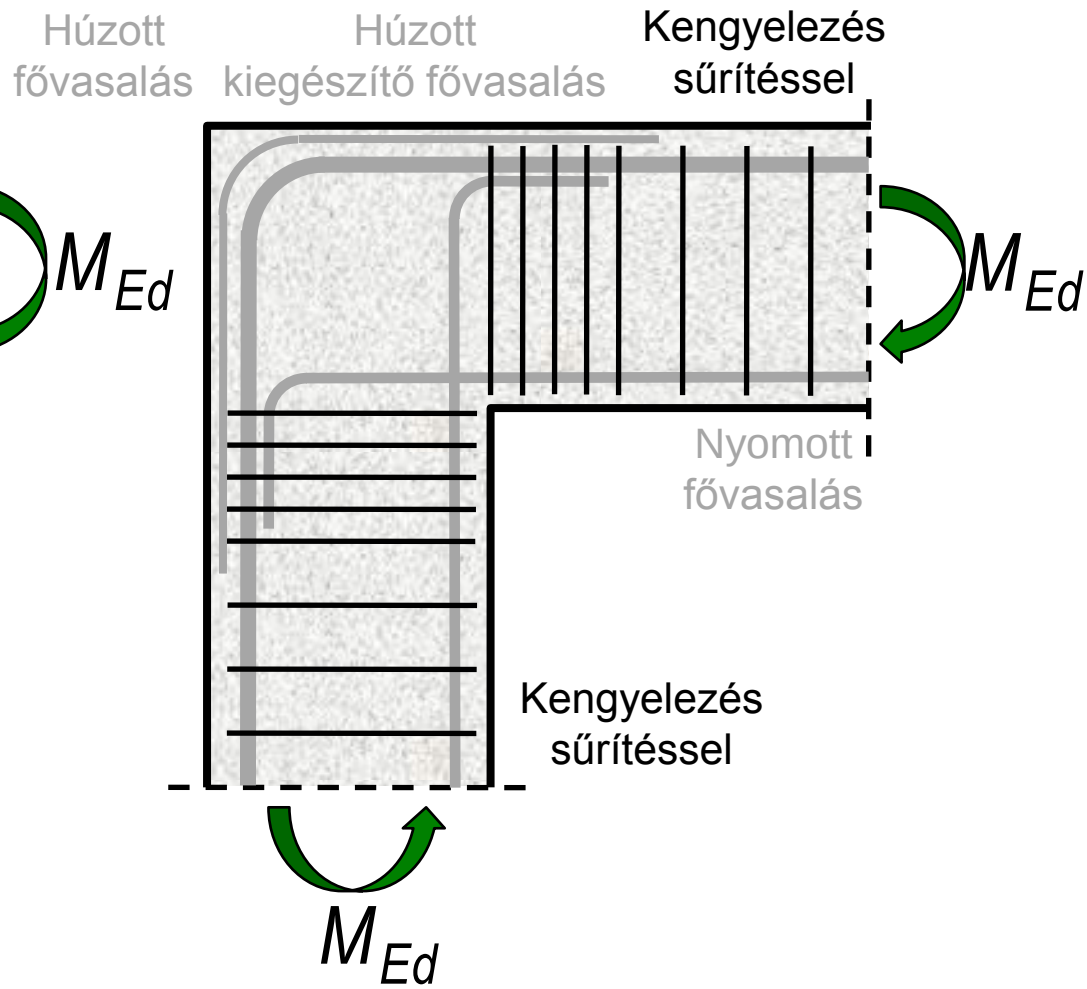
Reinforcing detail of a closing RC frame corner

Záródó vasbeton keretsarok vasvezetése





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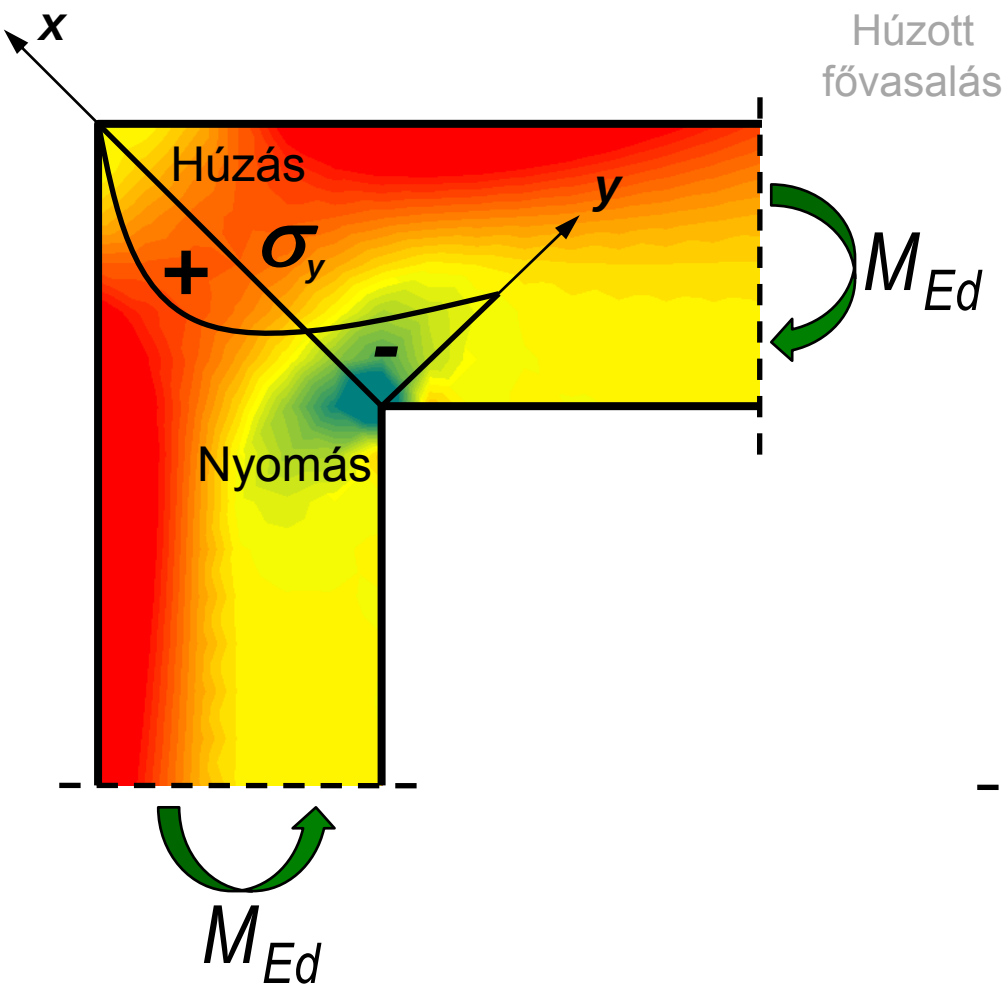
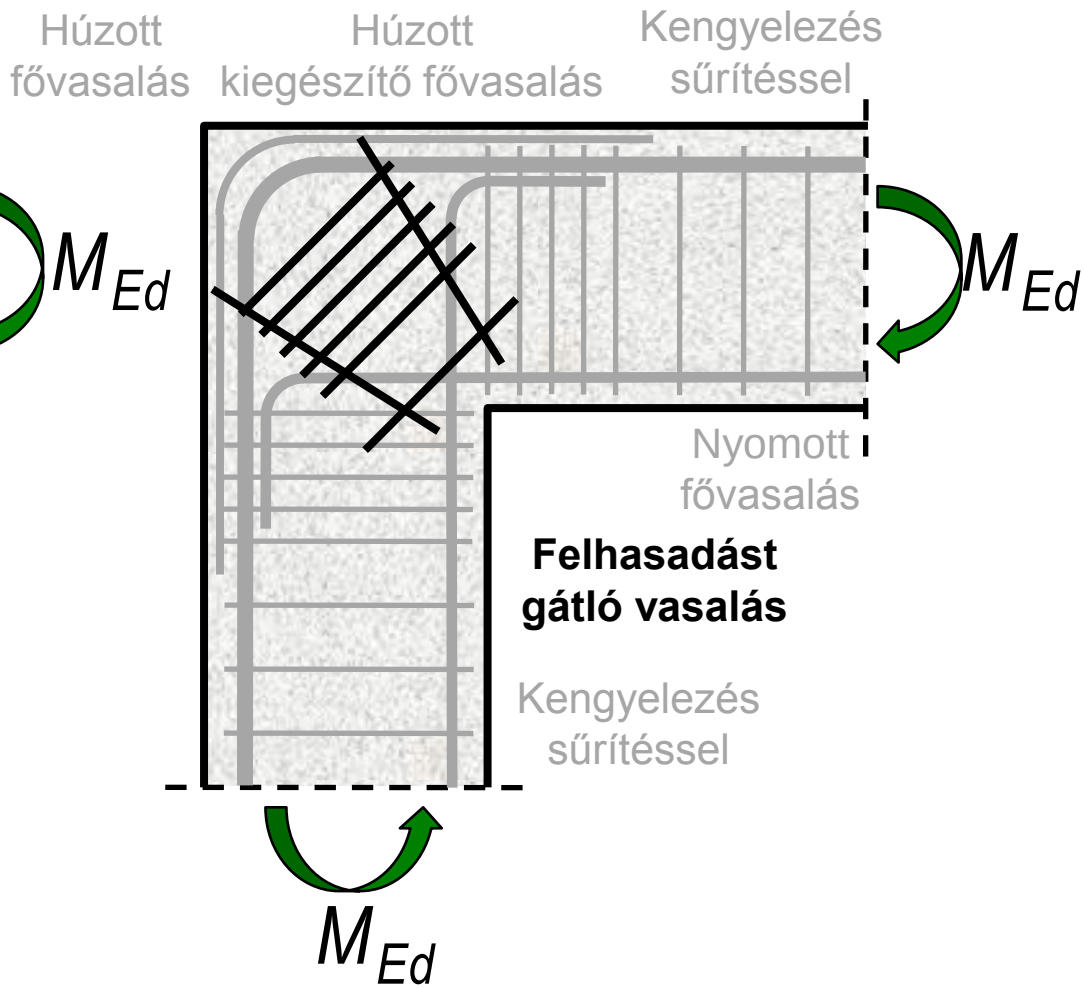
Reinforcing detail of a closing RC frame corner

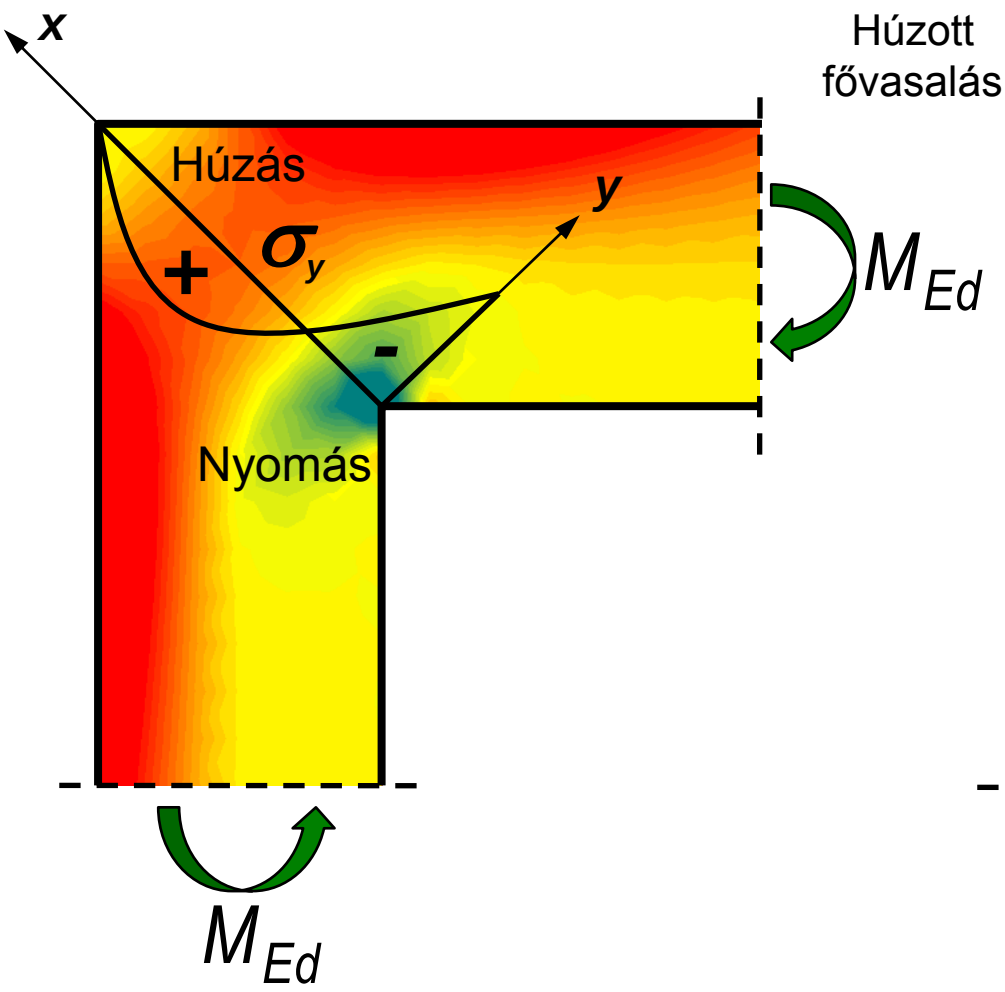
Záródó vasbeton keretsarok vasvezetése

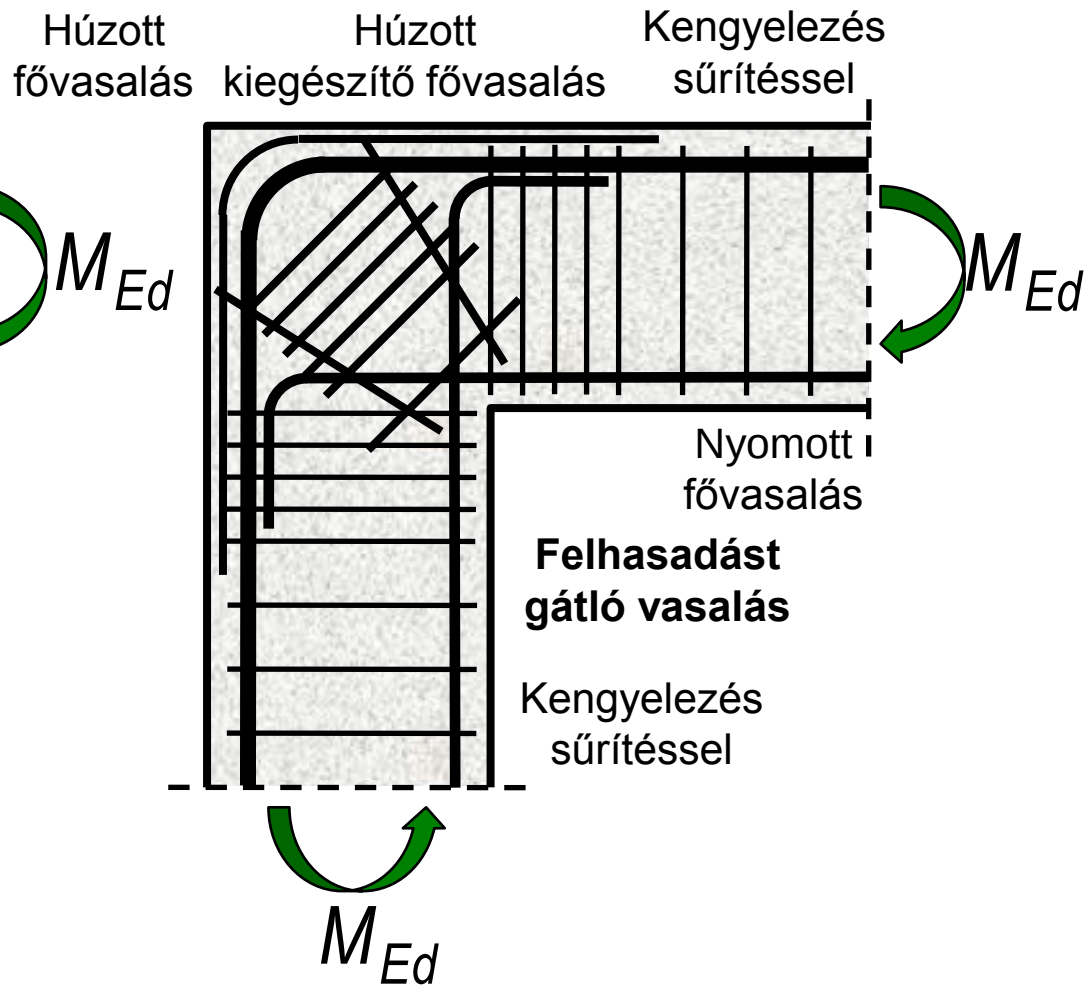




Reinforcing detail of a closing RC frame corner

Záródó vasbeton keretsarok vasvezetése





Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J2.(a), pp. 206.

Rácsostartó modell, MSZ EN 1992-1-1:2010, J2.(a) ábra, 206. oldal

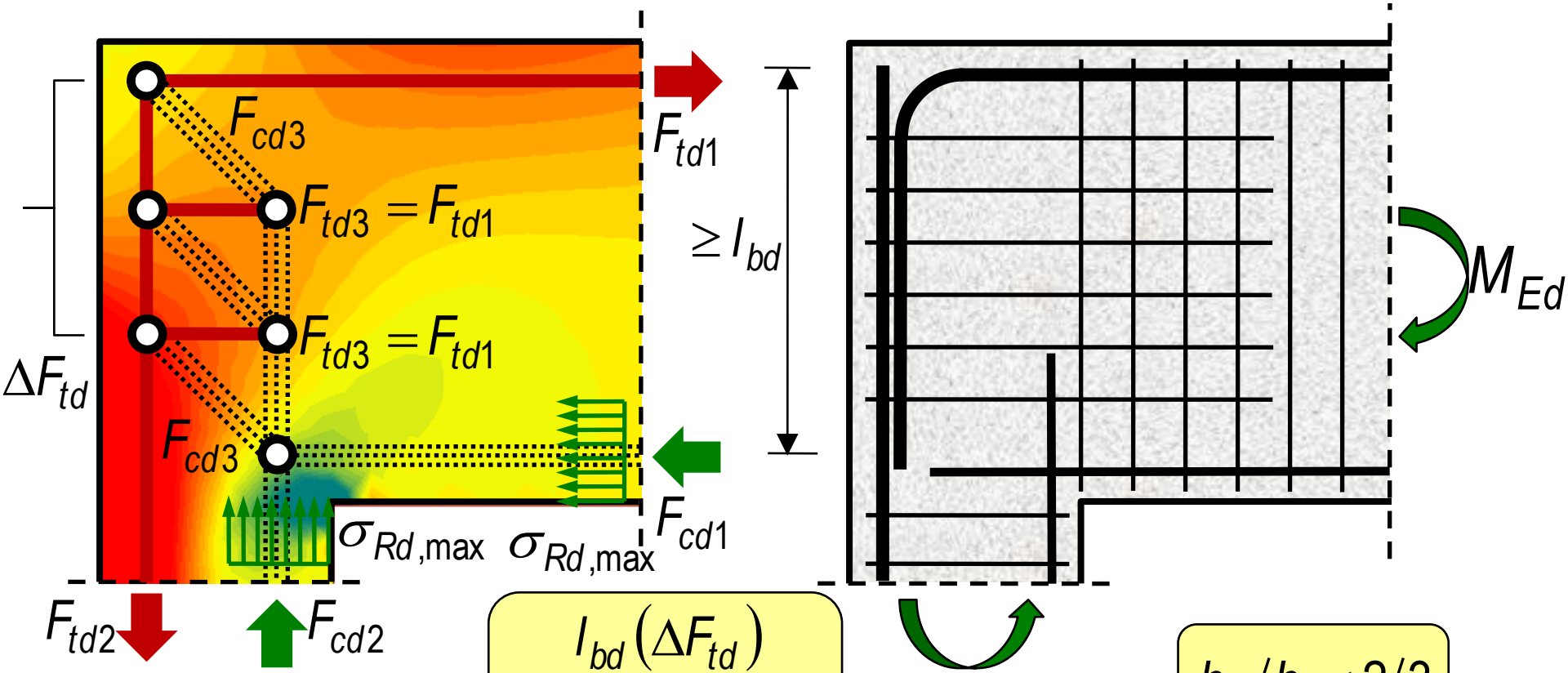
Záródó keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)

$$2/3 < h_2/h_1 < 3/2$$

Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J2.(b), pp. 206.

Rácsostartó modell, MSZ EN 1992-1-1:2010, J2.(b) ábra, 206. oldal

Záródó keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)



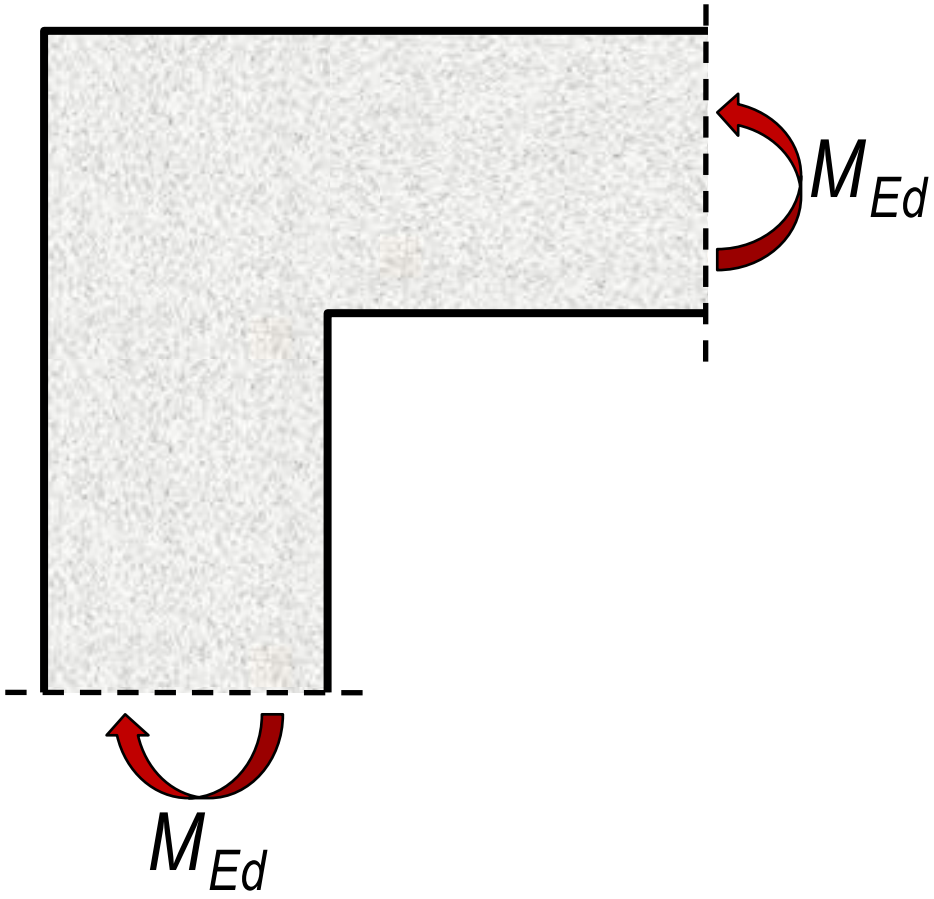
$$l_{bd}(\Delta F_{td})$$

$$\Delta F_{td} = F_{td2} - F_{td1}$$

$$h_2 / h_1 < 2/3$$

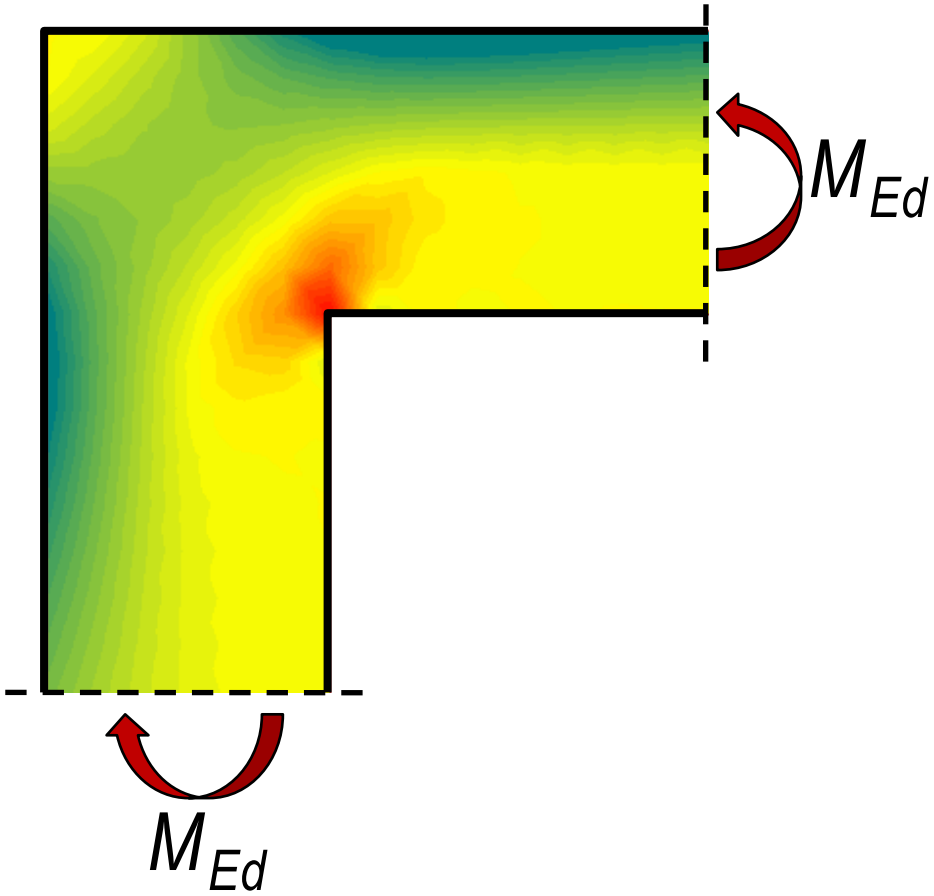
Opening RC frame corner

Nyíló vasbeton keretsarok



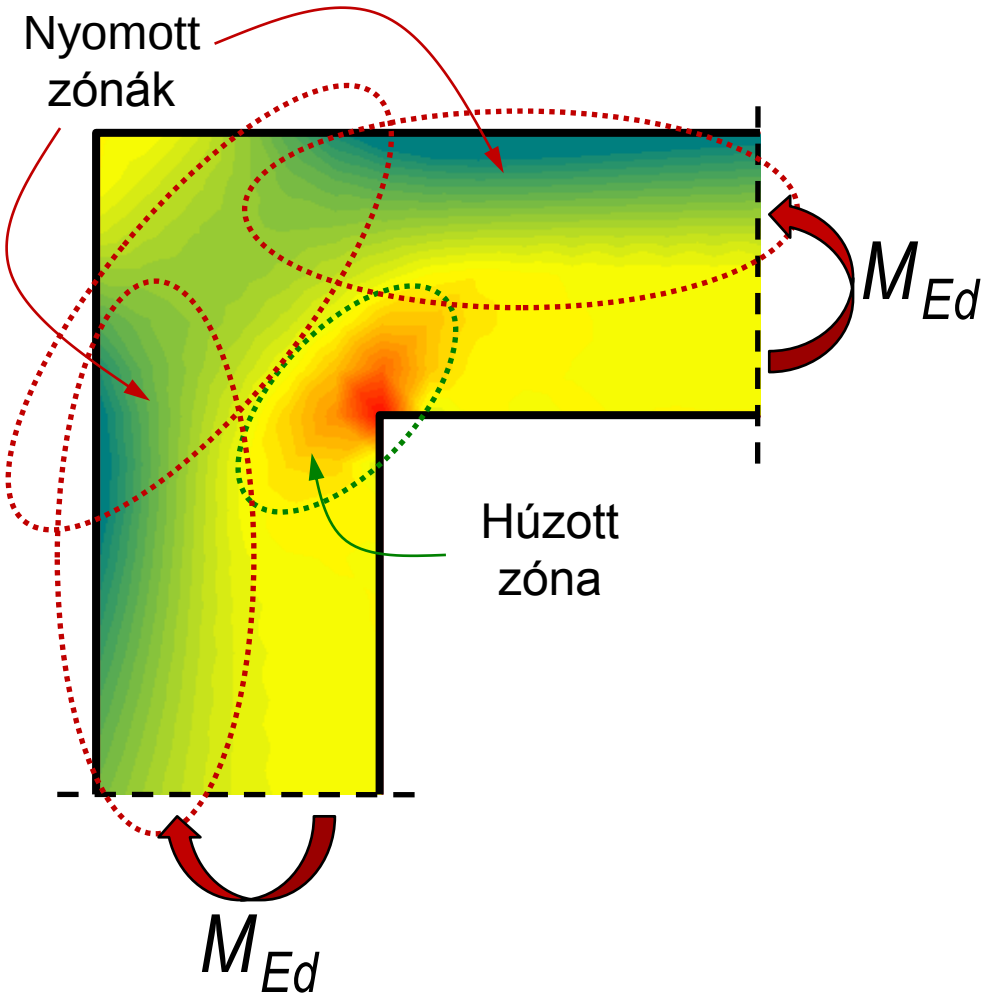
Main stresses of an opening RC frame corner

Nyíló vasbeton keretsarok főfeszültségei



Tensioned and compressed zones of an opening RC frame corner

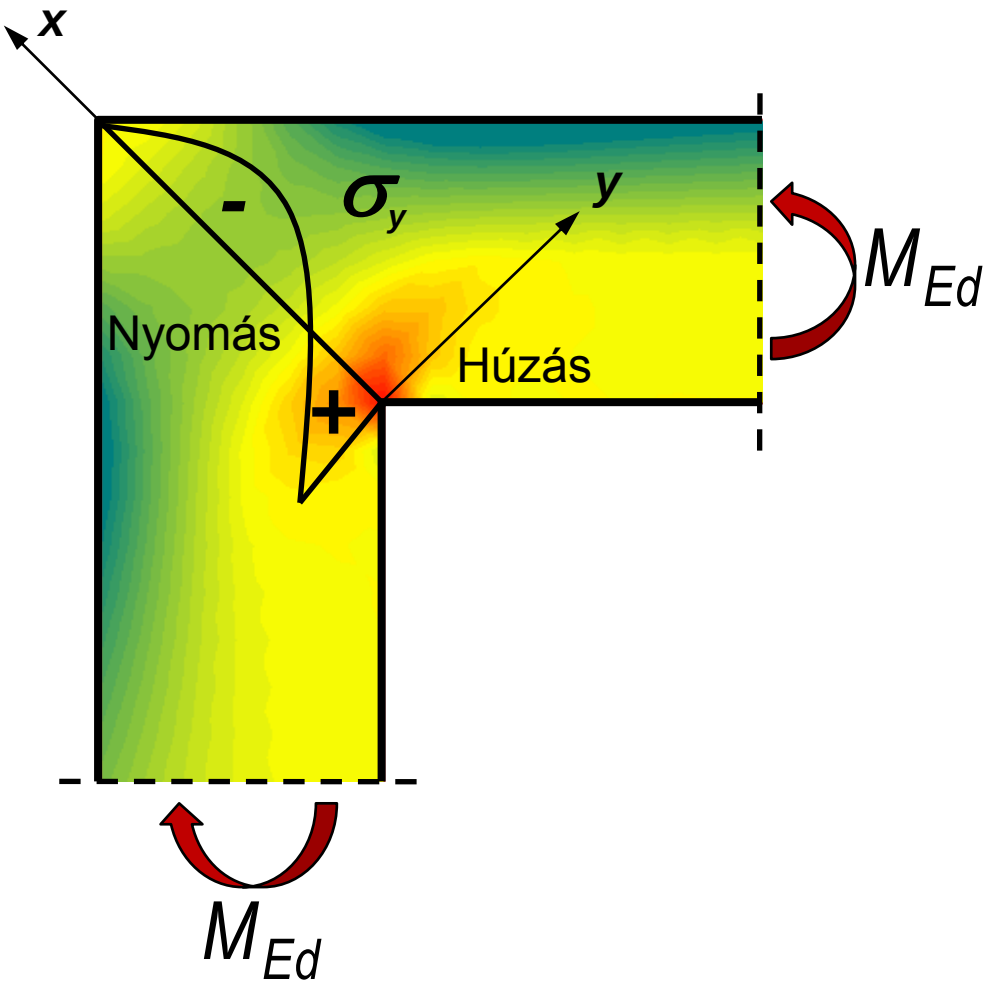
Nyíló vasbeton keretsarok húzott és nyomott zónái



Dr. Kovács Imre PhD © Minden jog fenntartva!!!

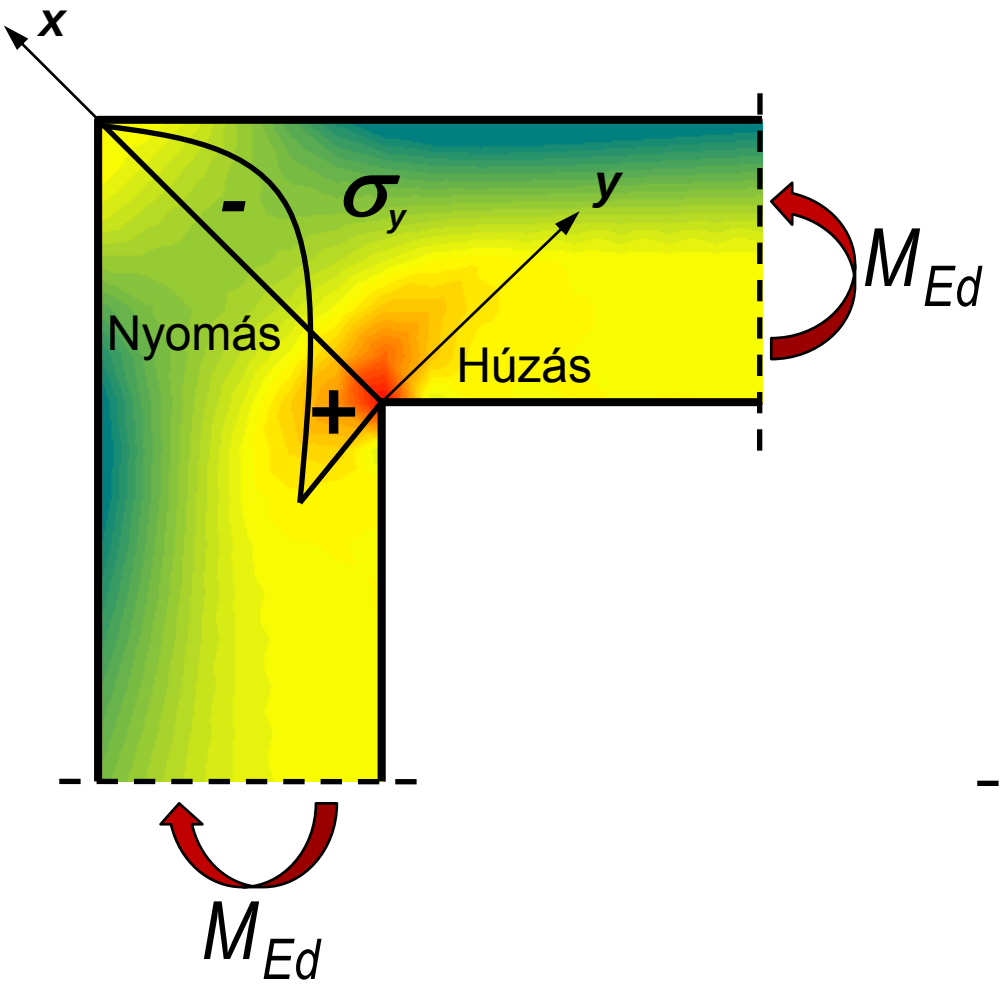
Tensioned and compressed zones of an opening RC frame corner

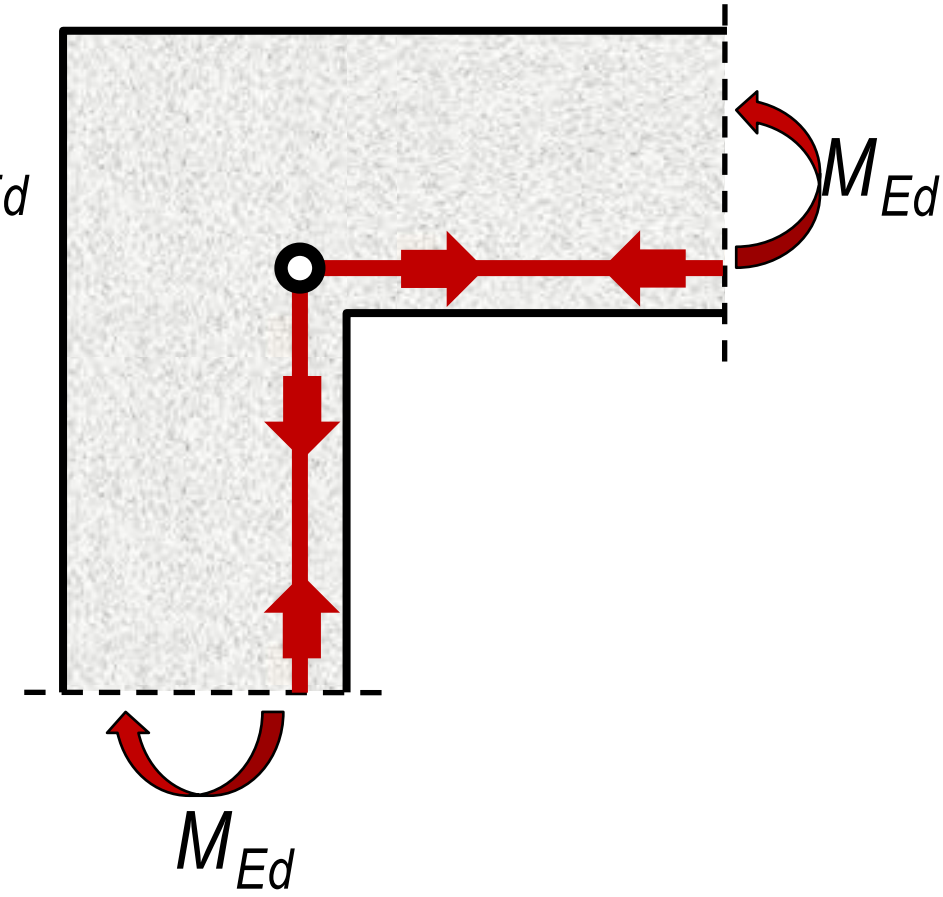
Nyíló vasbeton keretsarok húzott és nyomott zónái



Force flow of an opening RC frame corner

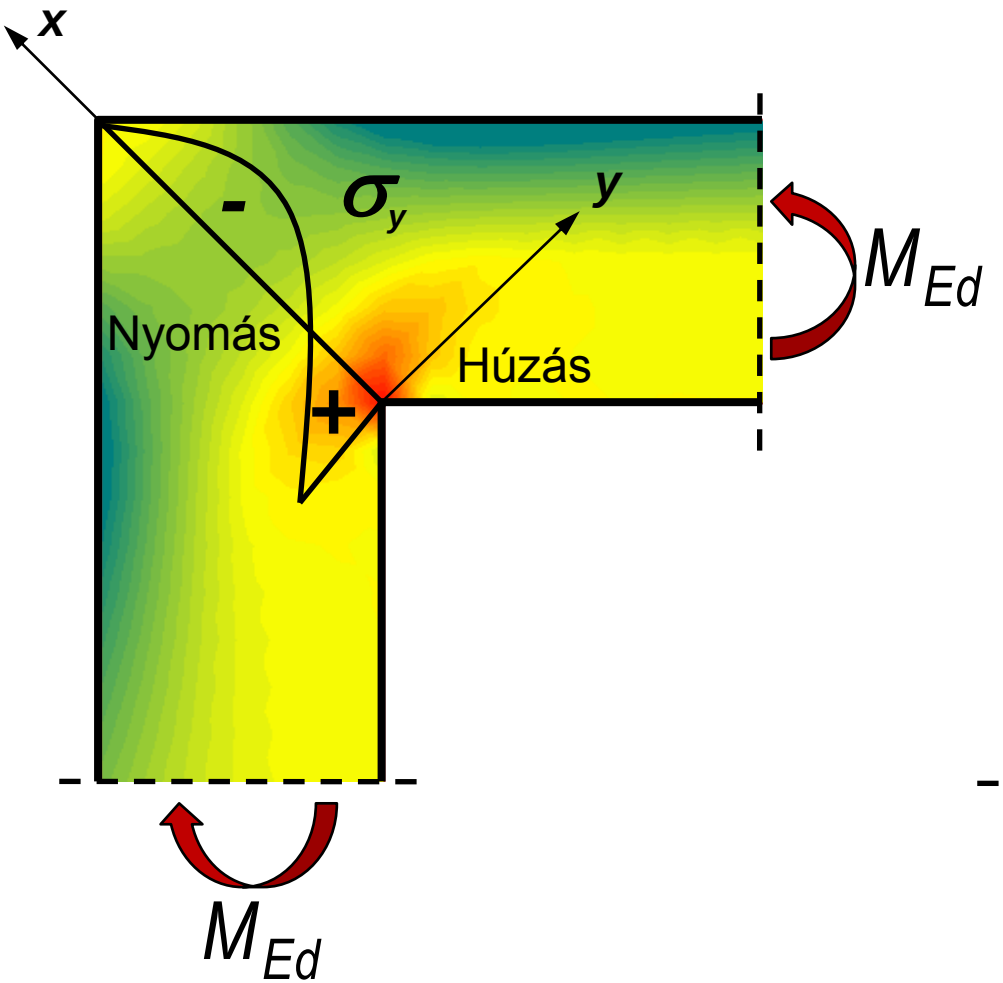
Nyíló vasbeton keretsarok erőjátéka

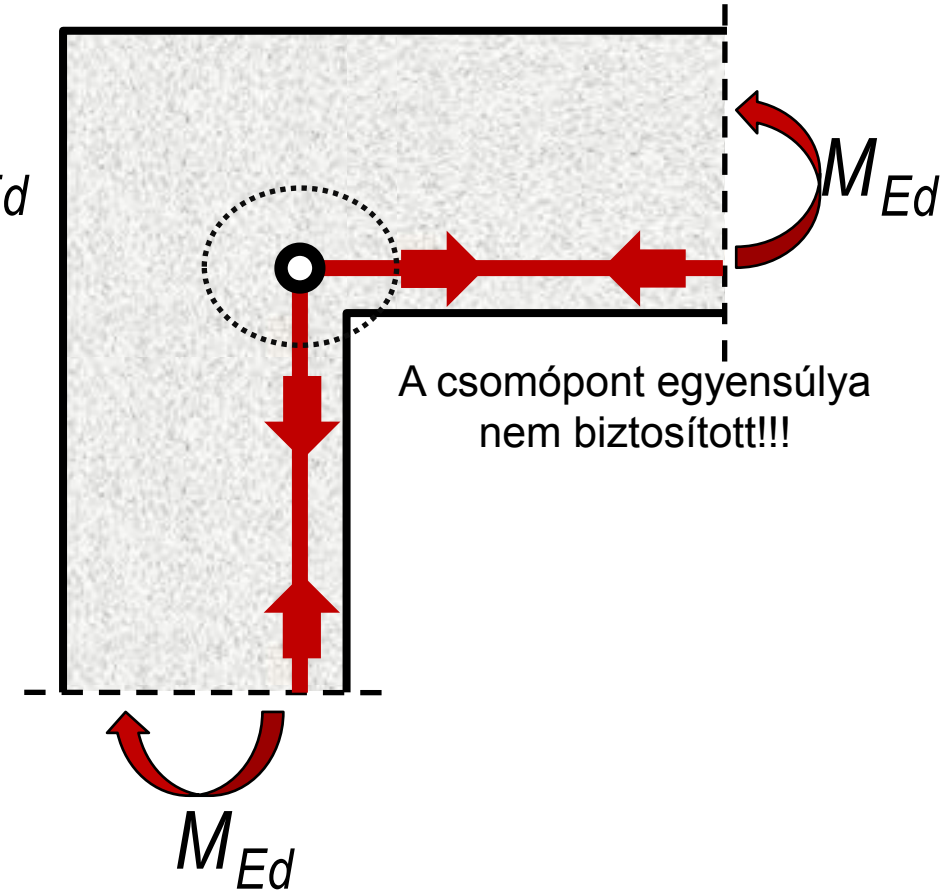




Force flow of an opening RC frame corner

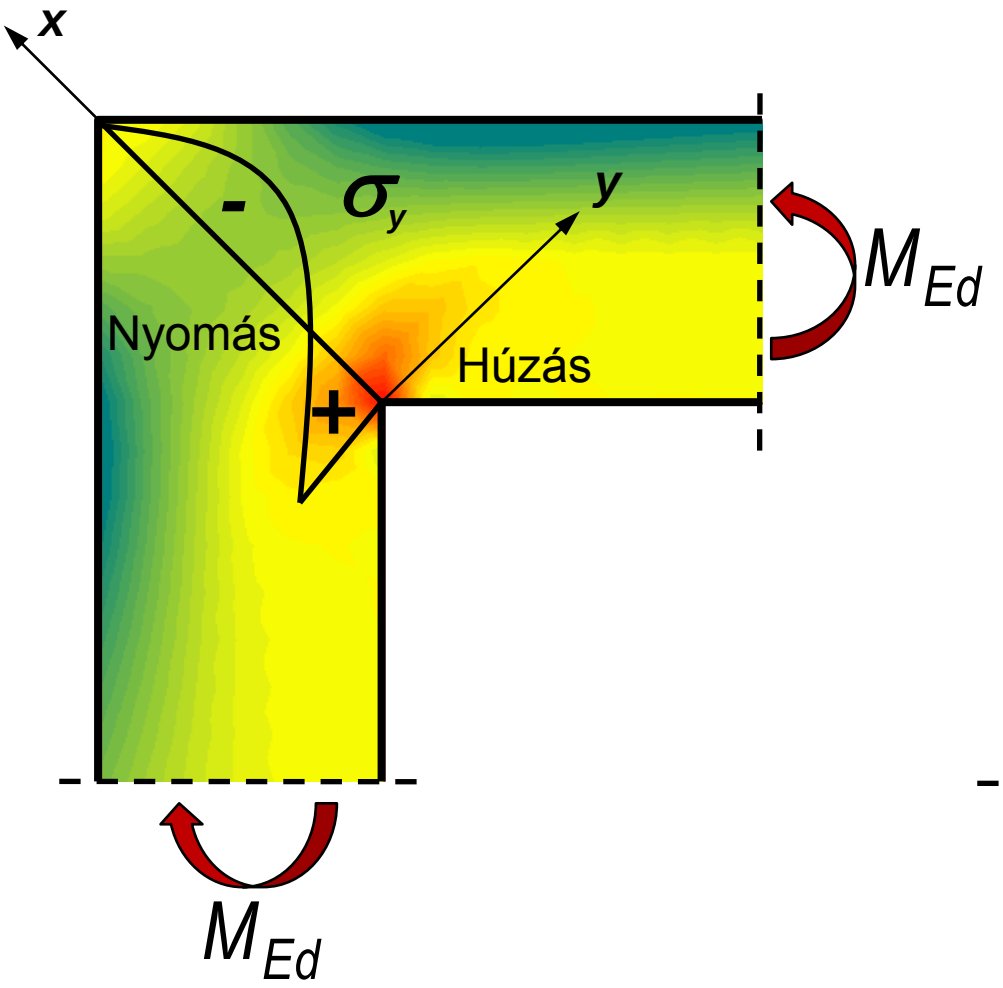
Nyíló vasbeton keretsarok erőjátéka

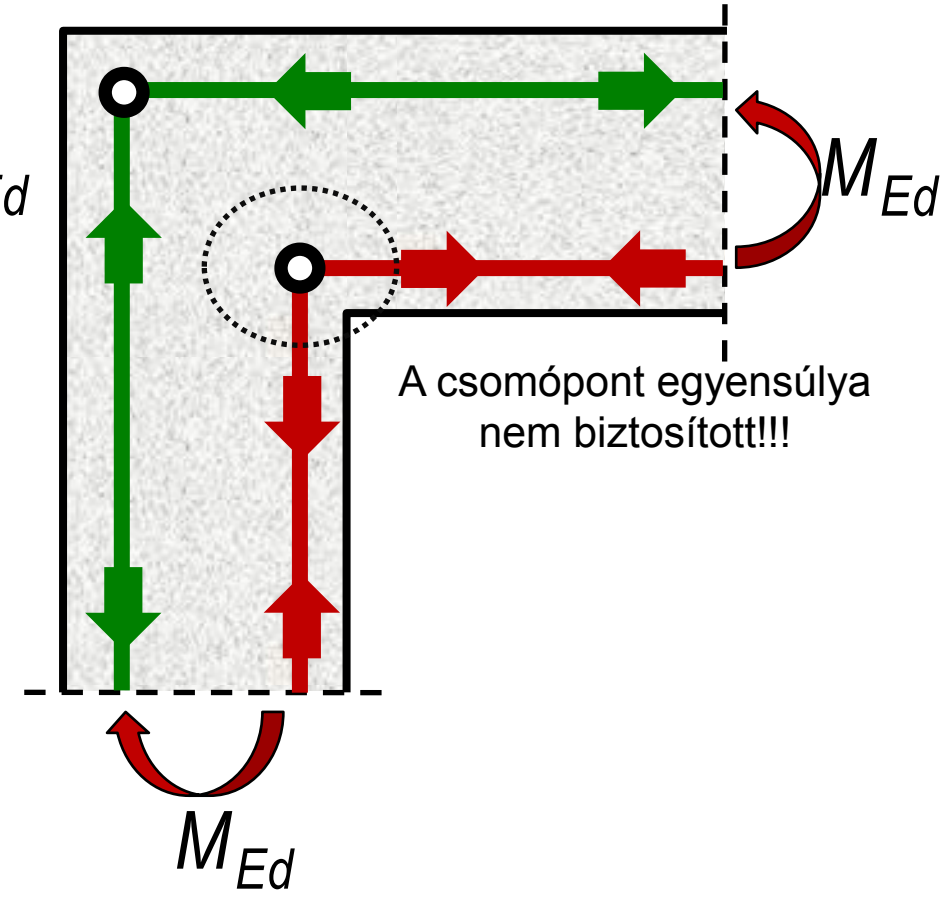




Force flow of an opening RC frame corner

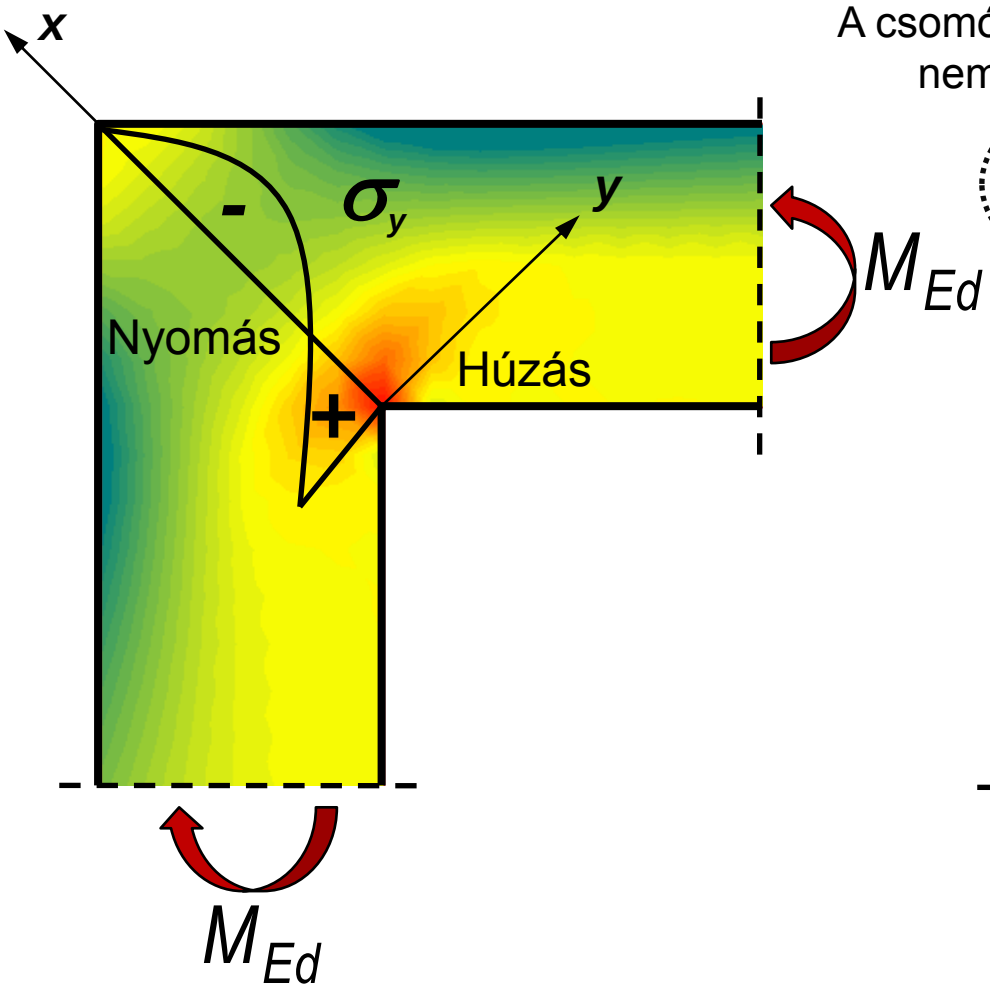
Nyíló vasbeton keretsarok erőjátéka

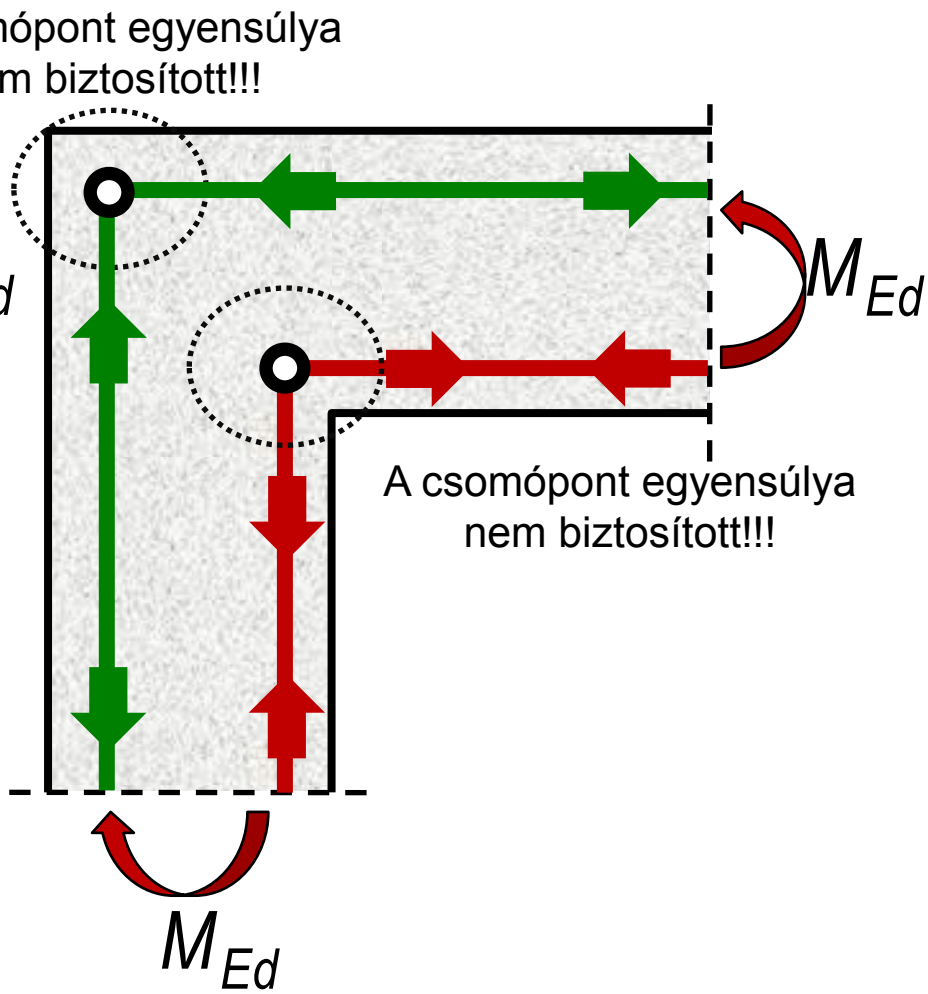




Force flow of an opening RC frame corner

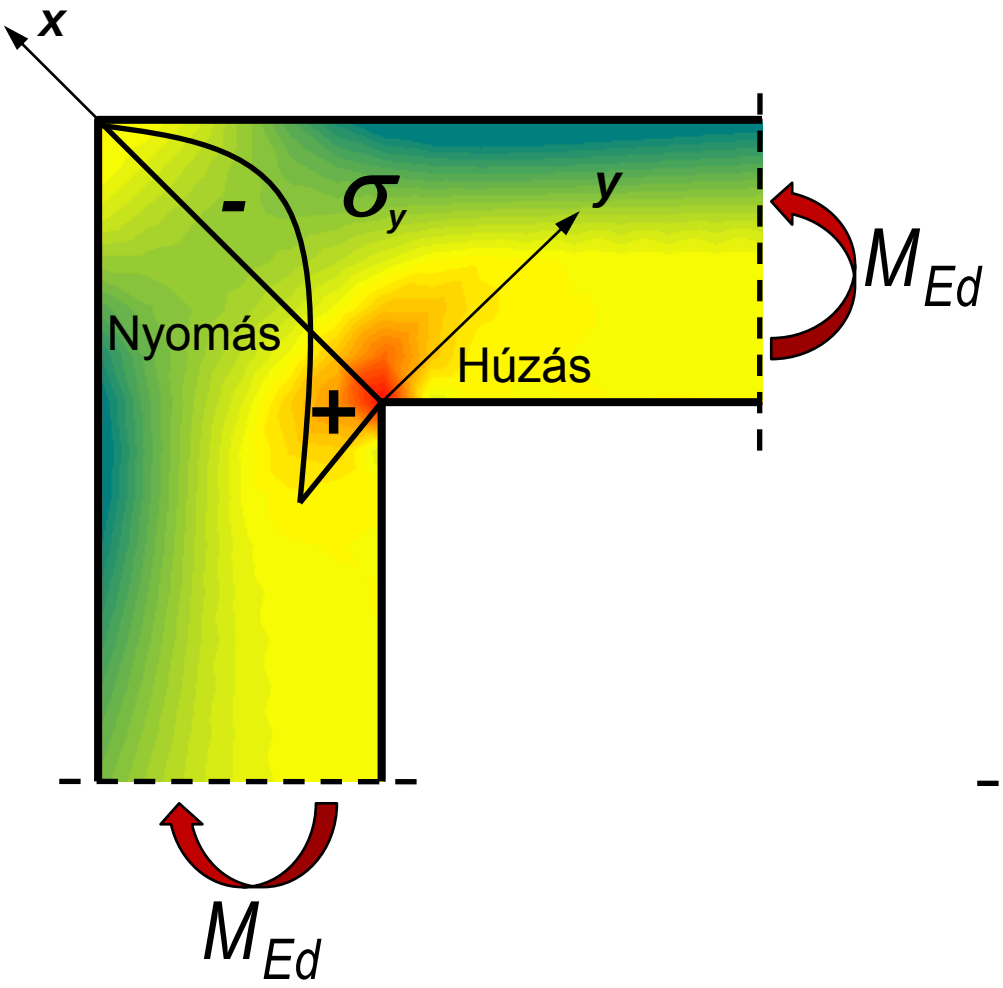
Nyíló vasbeton keretsarok erőjátéka

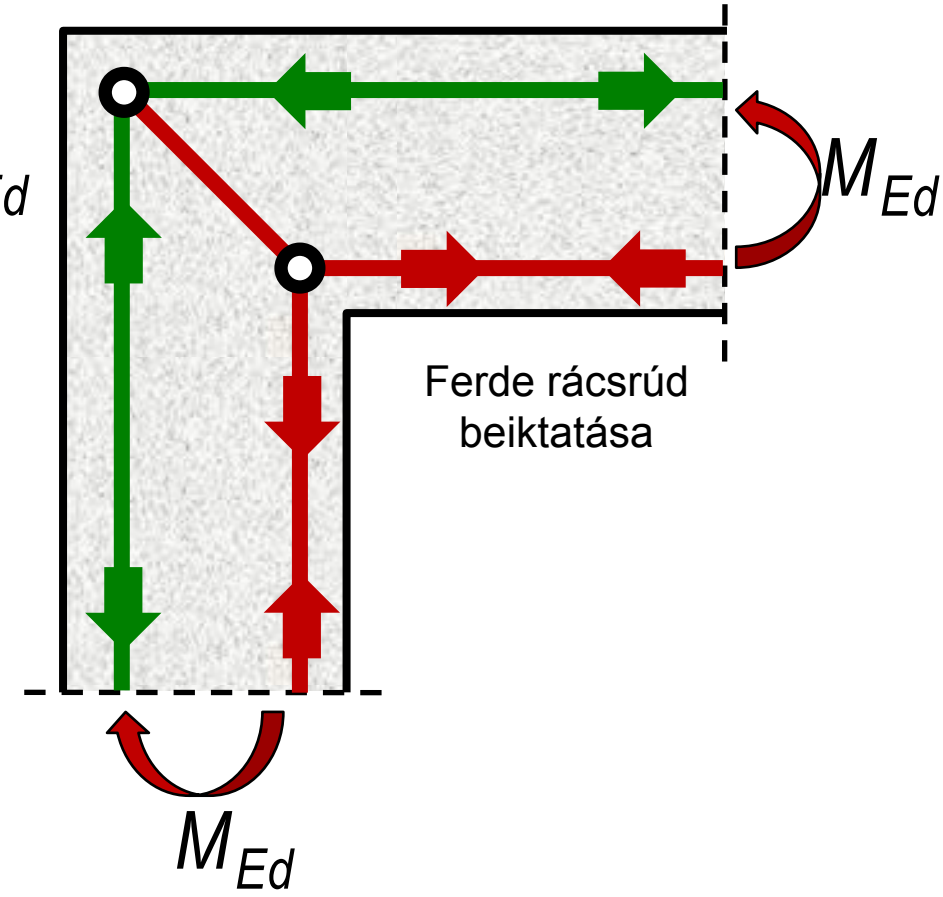




Force flow of an opening RC frame corner

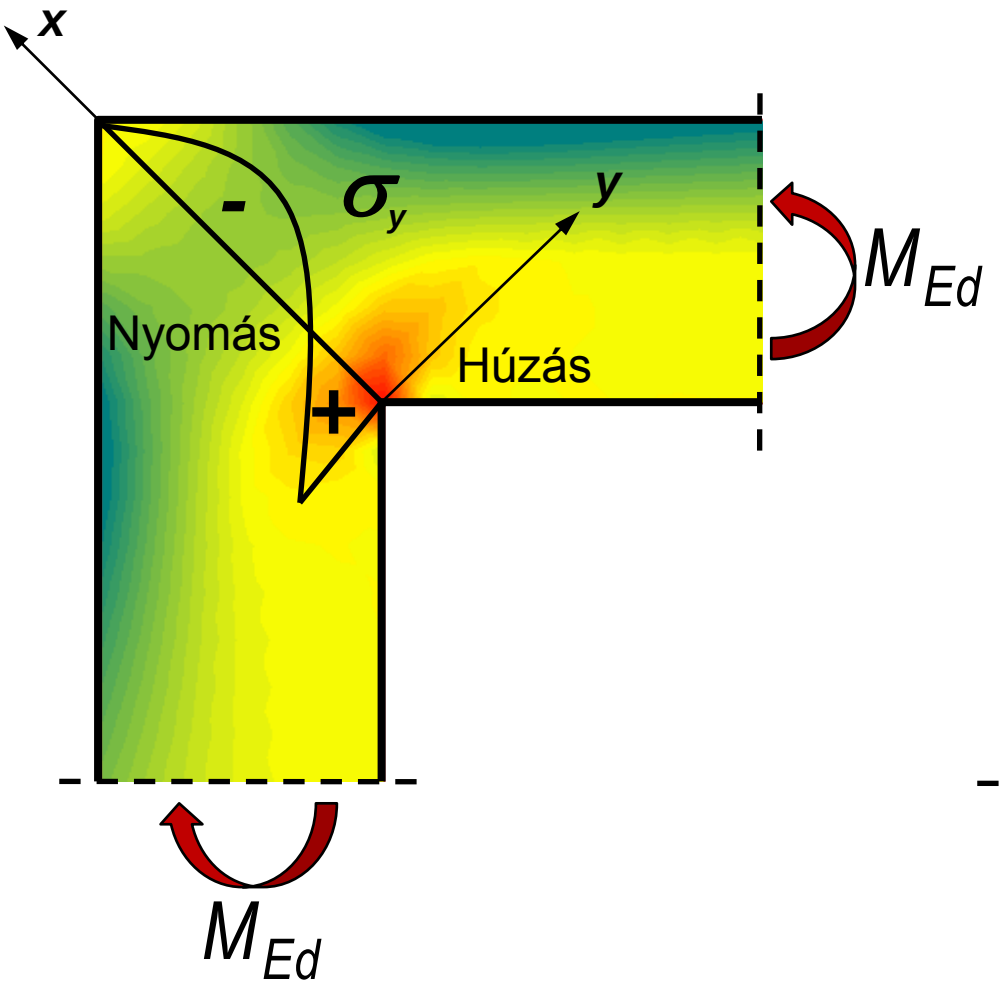
Nyíló vasbeton keretsarok erőjátéka

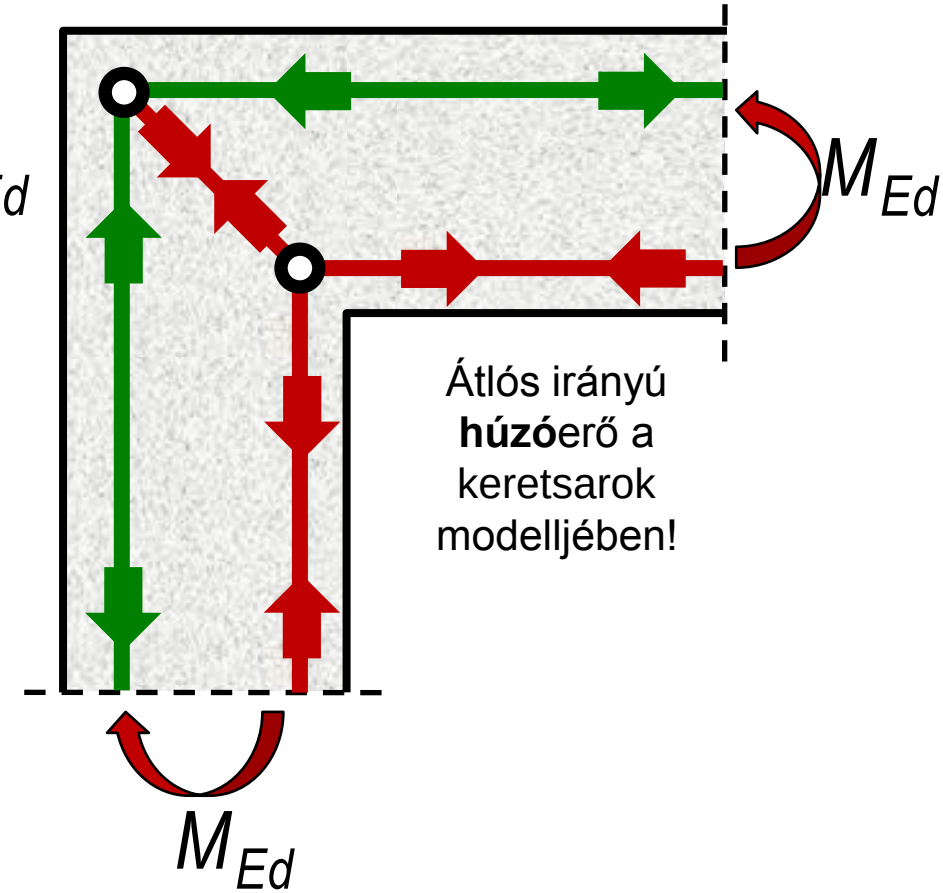




Force flow of an opening RC frame corner

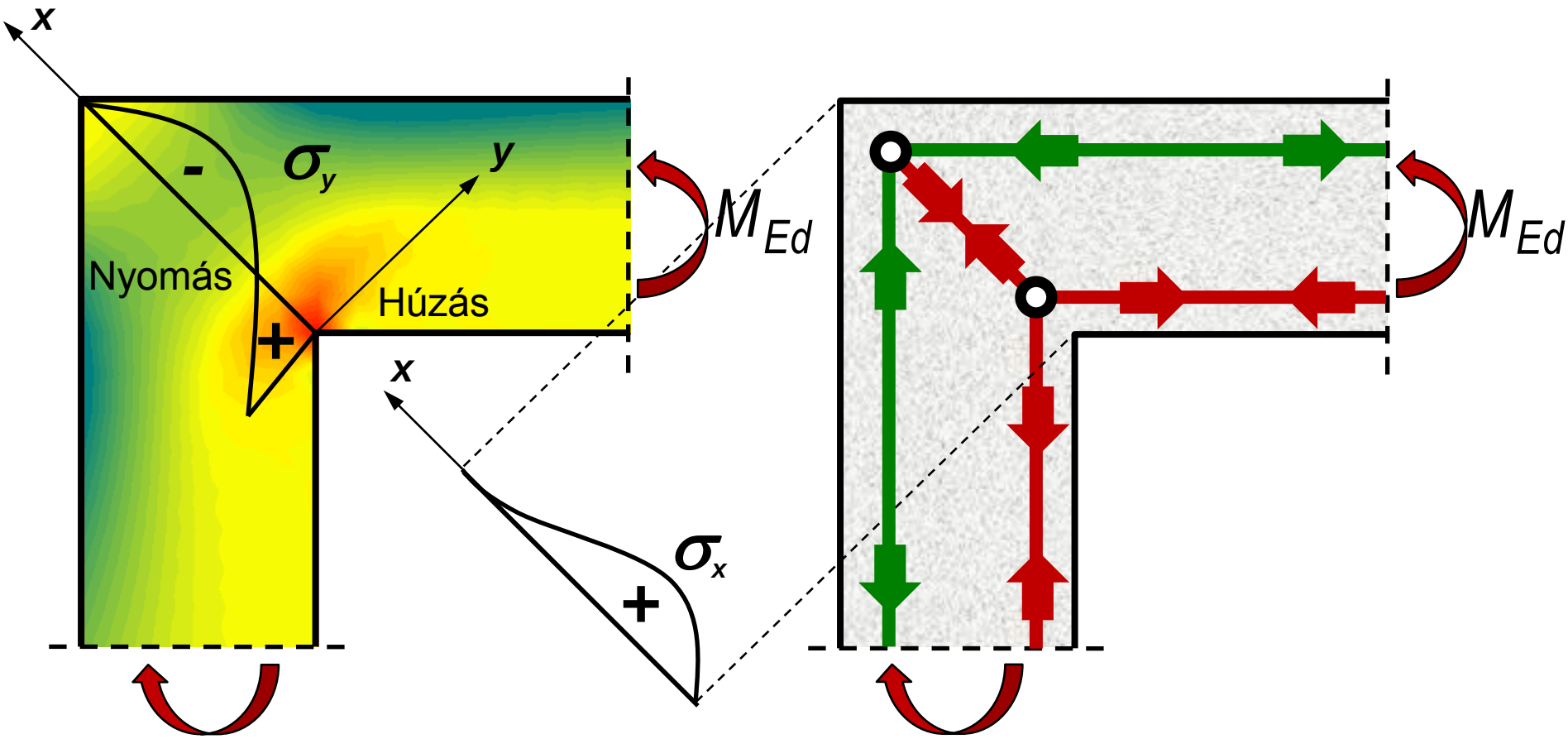
Nyíló vasbeton keretsarok erőjátéka





Force flow of an opening RC frame corner

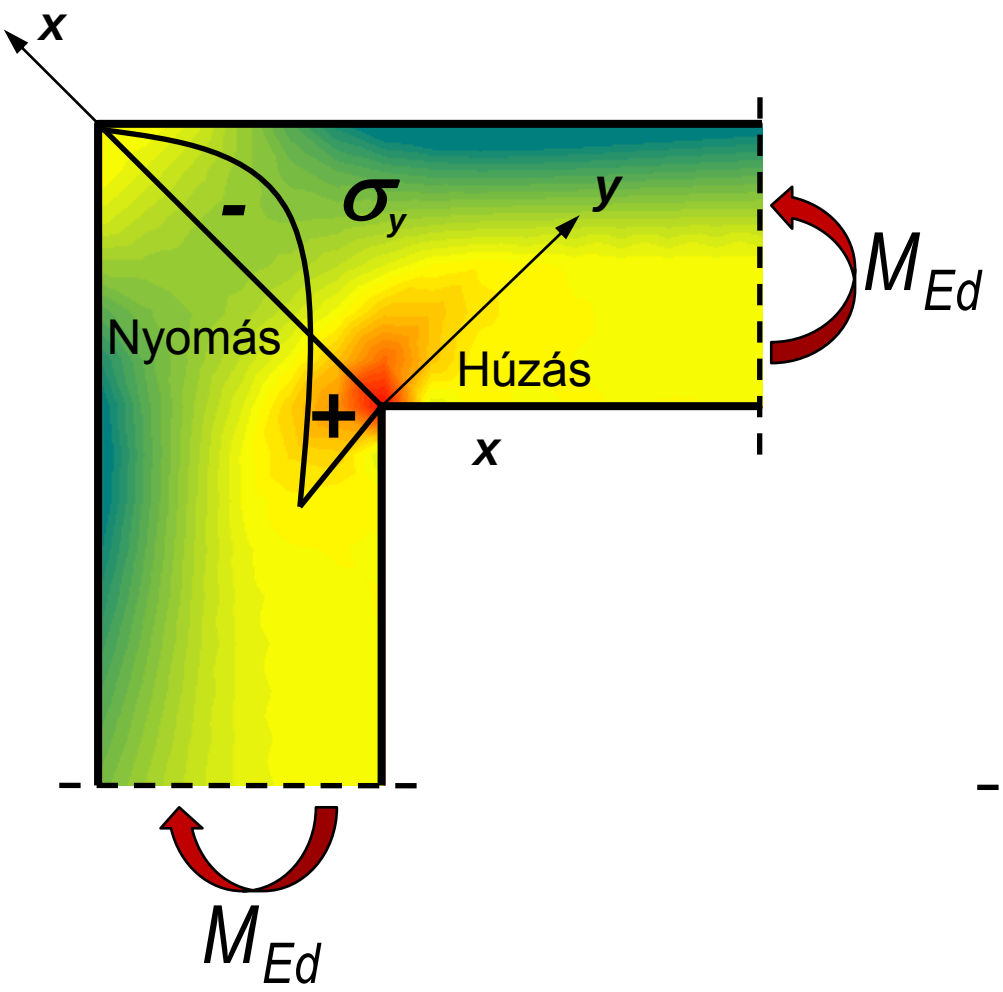
Nyíló vasbeton keretsarok erőjátéka

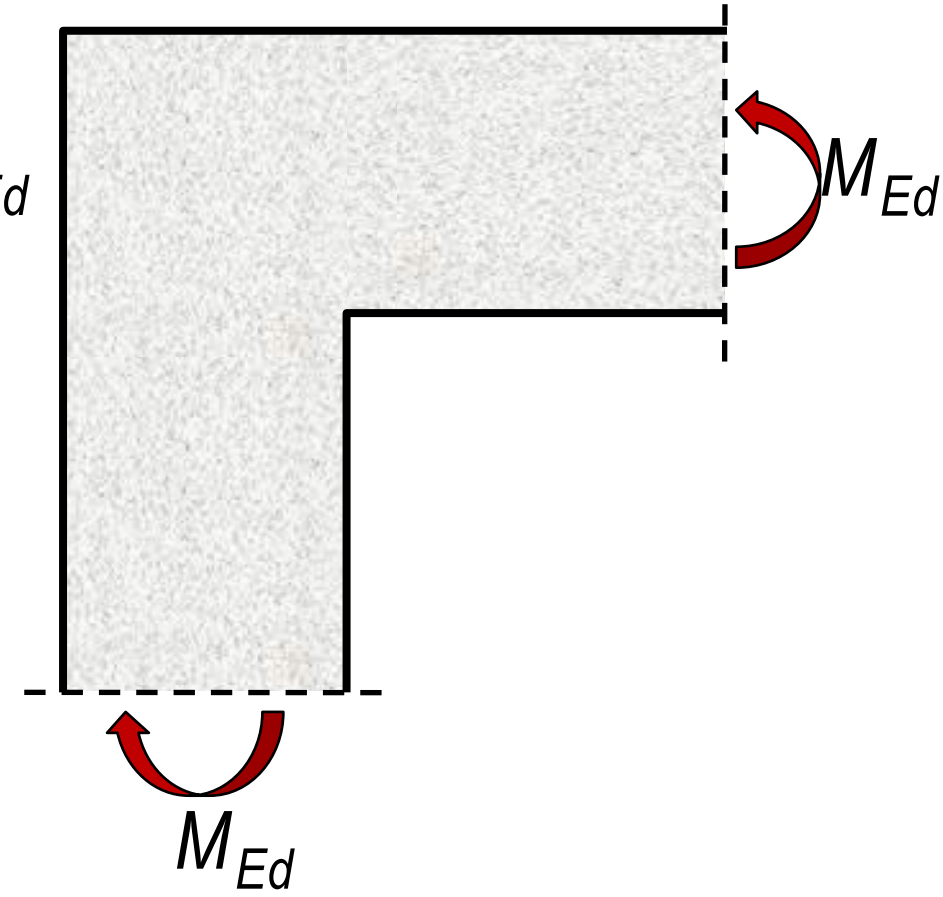


Átlós irányú **húzó**feszültségek eloszlása a keretsarokban

Reinforcing detail of an opening RC frame corner

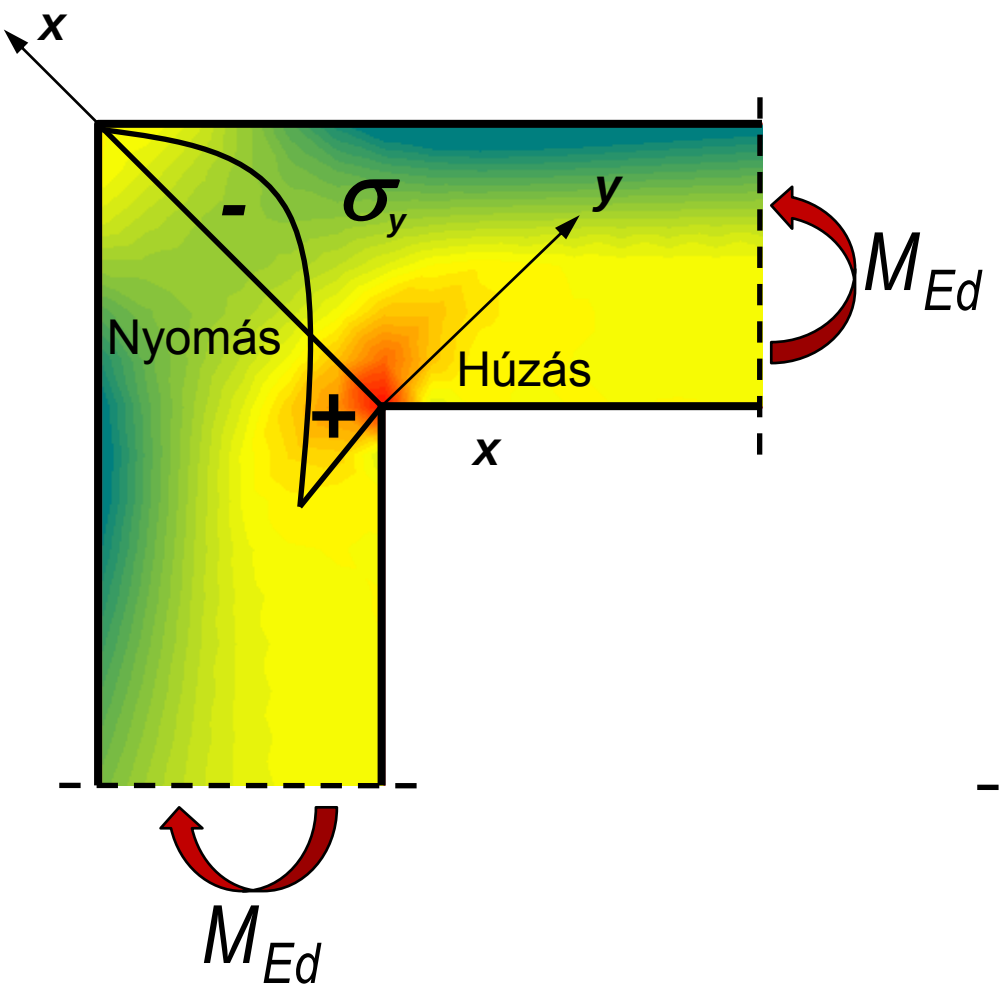
Nyíló vasbeton keretsarok vasvezetése

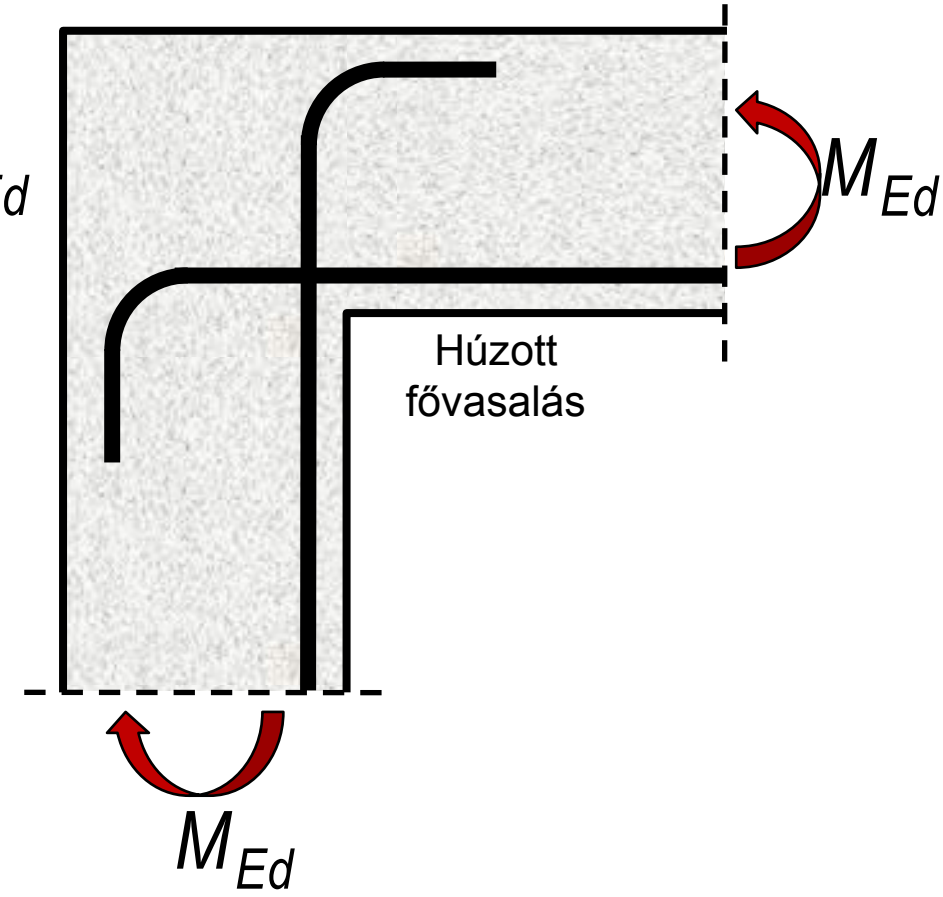




Reinforcing detail of an opening RC frame corner

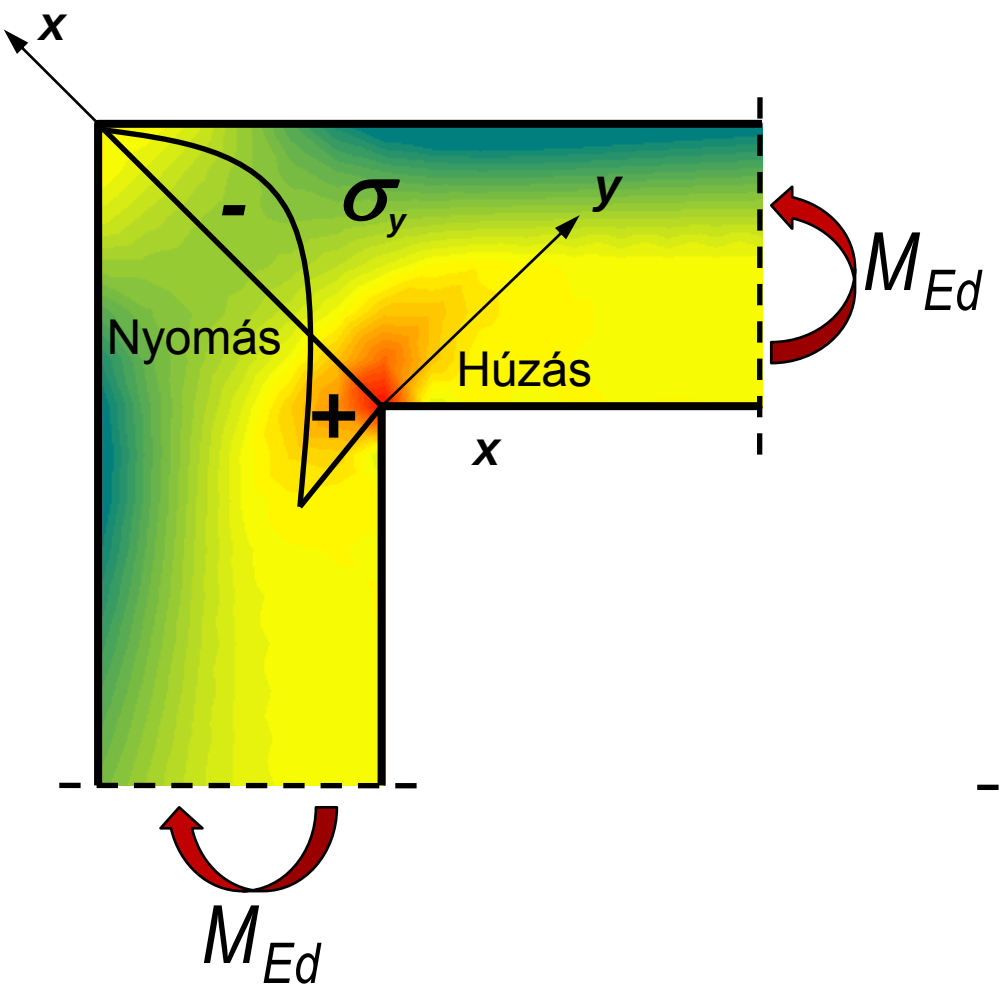
Nyíló vasbeton keretsarok vasvezetése

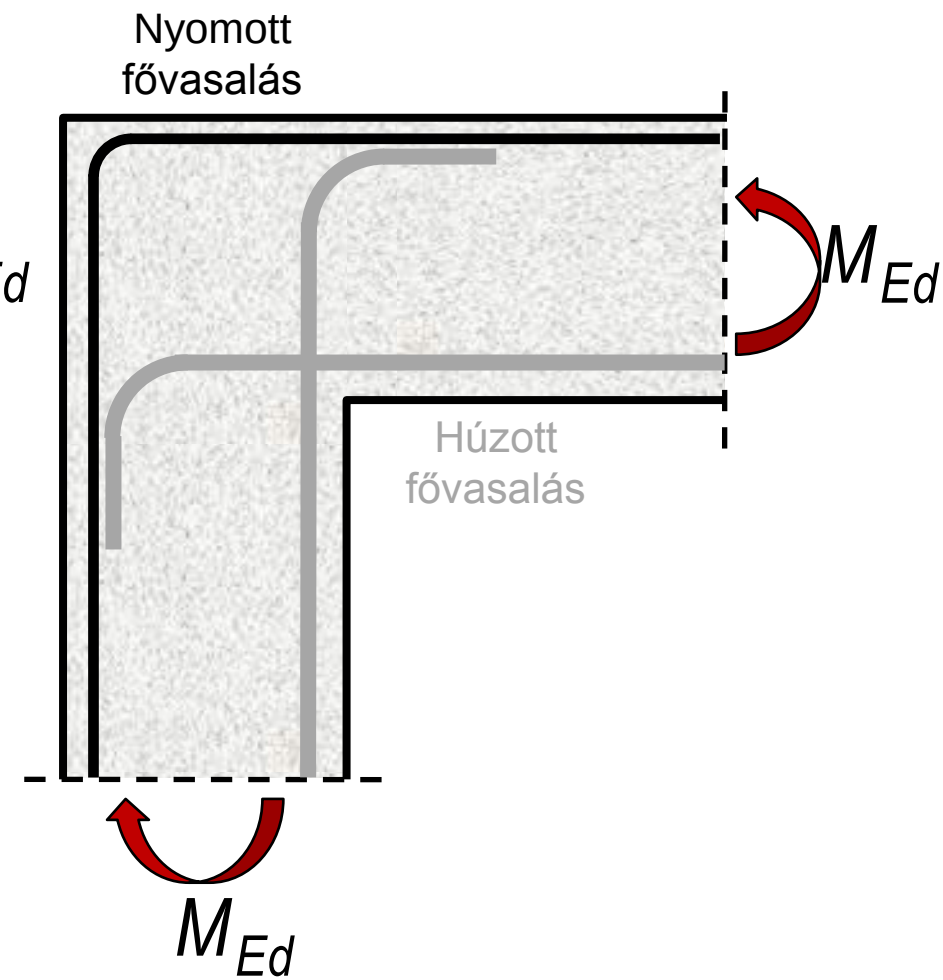




Reinforcing detail of an opening RC frame corner

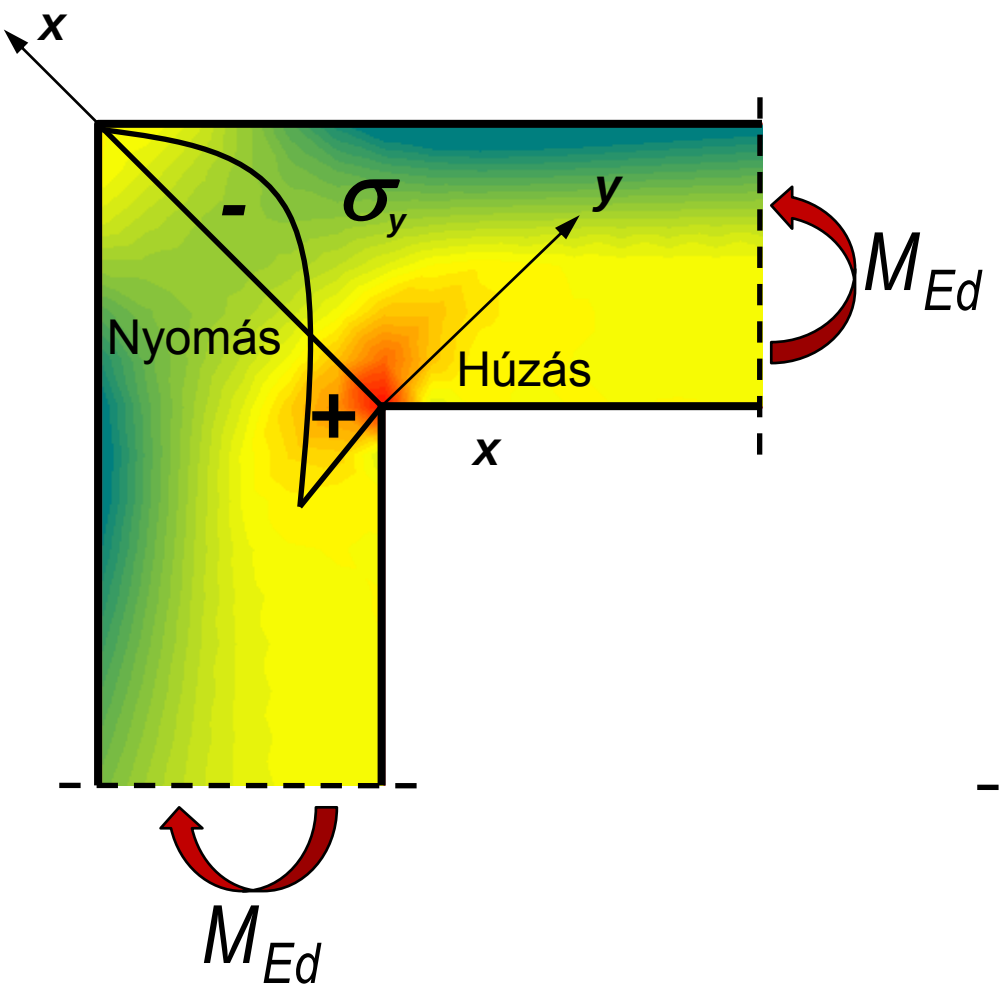
Nyíló vasbeton keretsarok vasvezetése

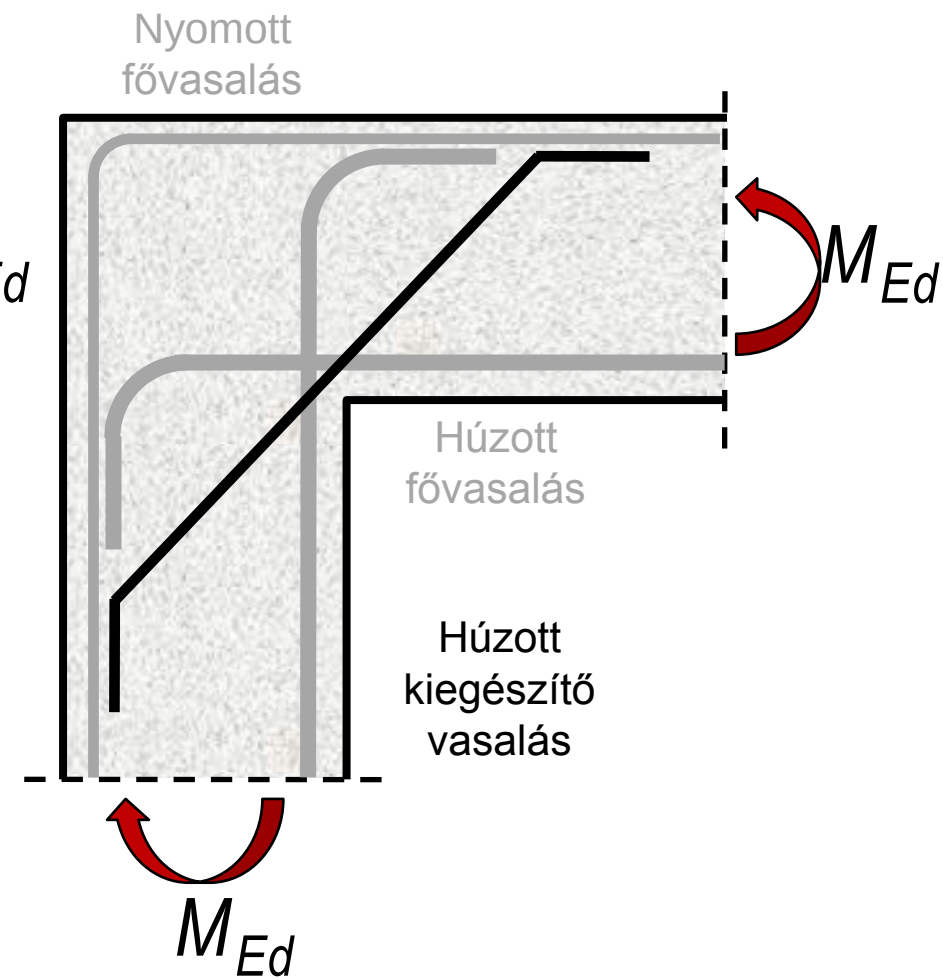




Reinforcing detail of an opening RC frame corner

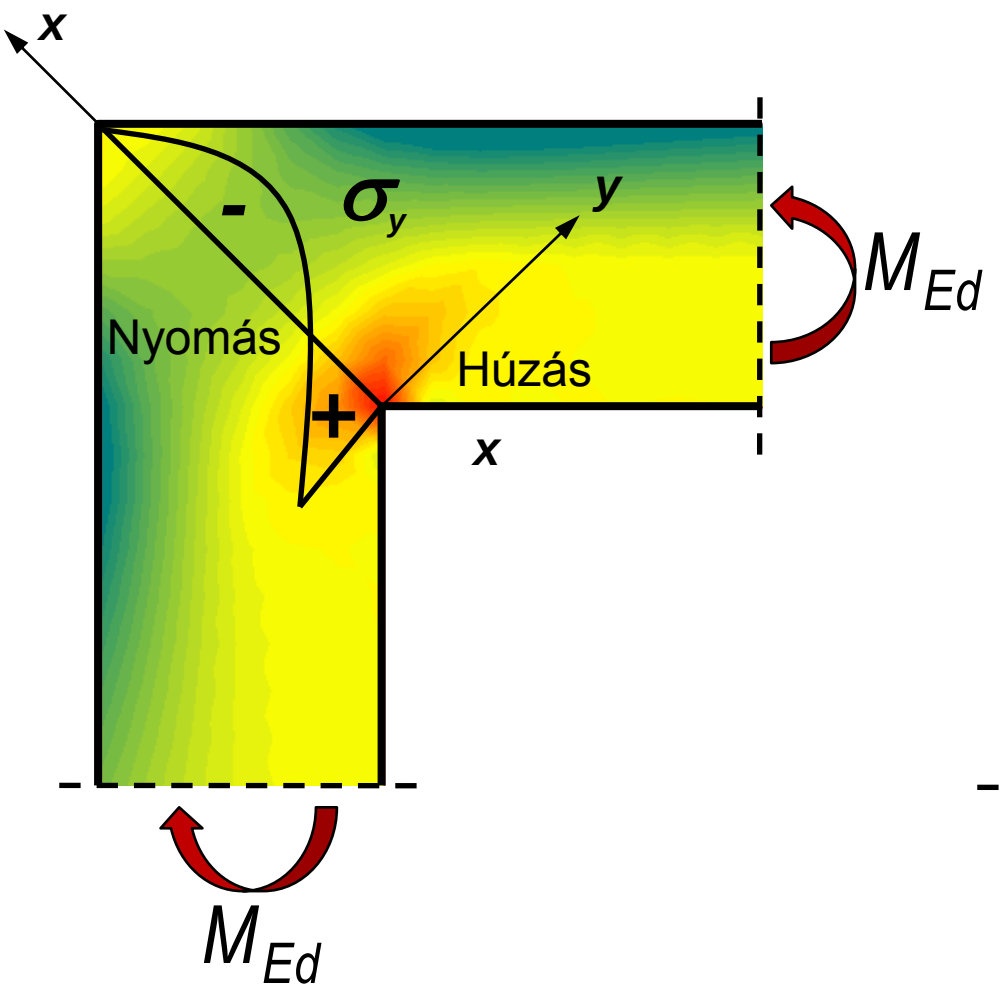
Nyíló vasbeton keretsarok vasvezetése

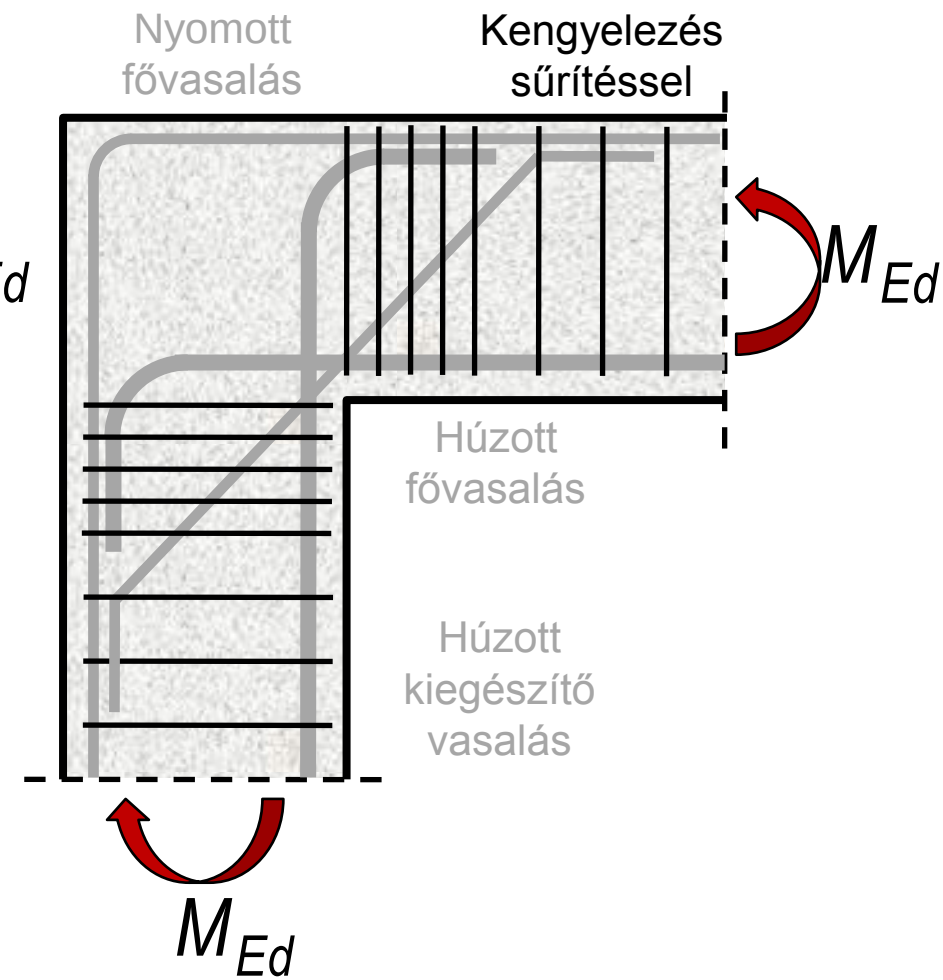




Reinforcing detail of an opening RC frame corner

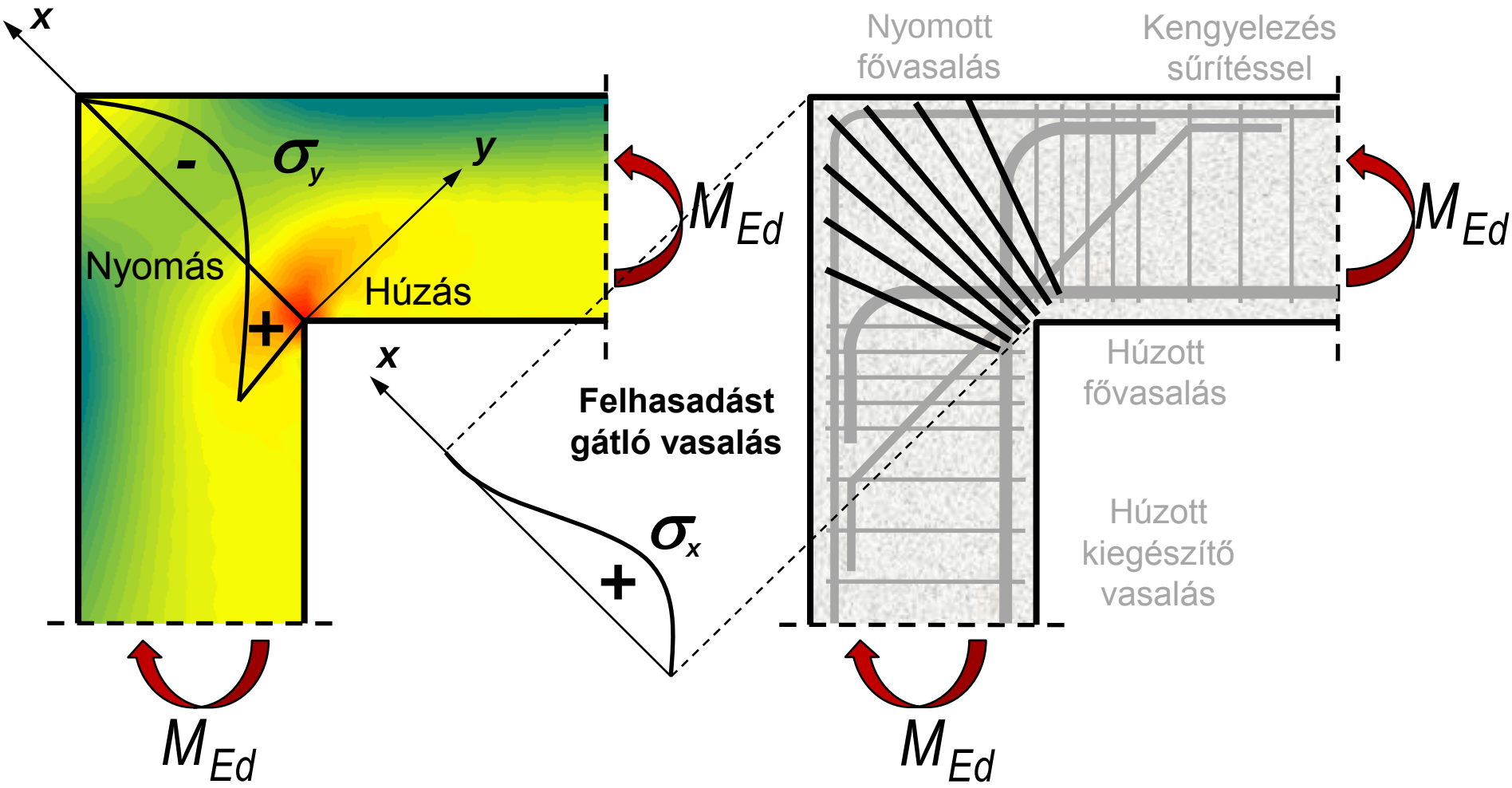
Nyíló vasbeton keretsarok vasvezetése





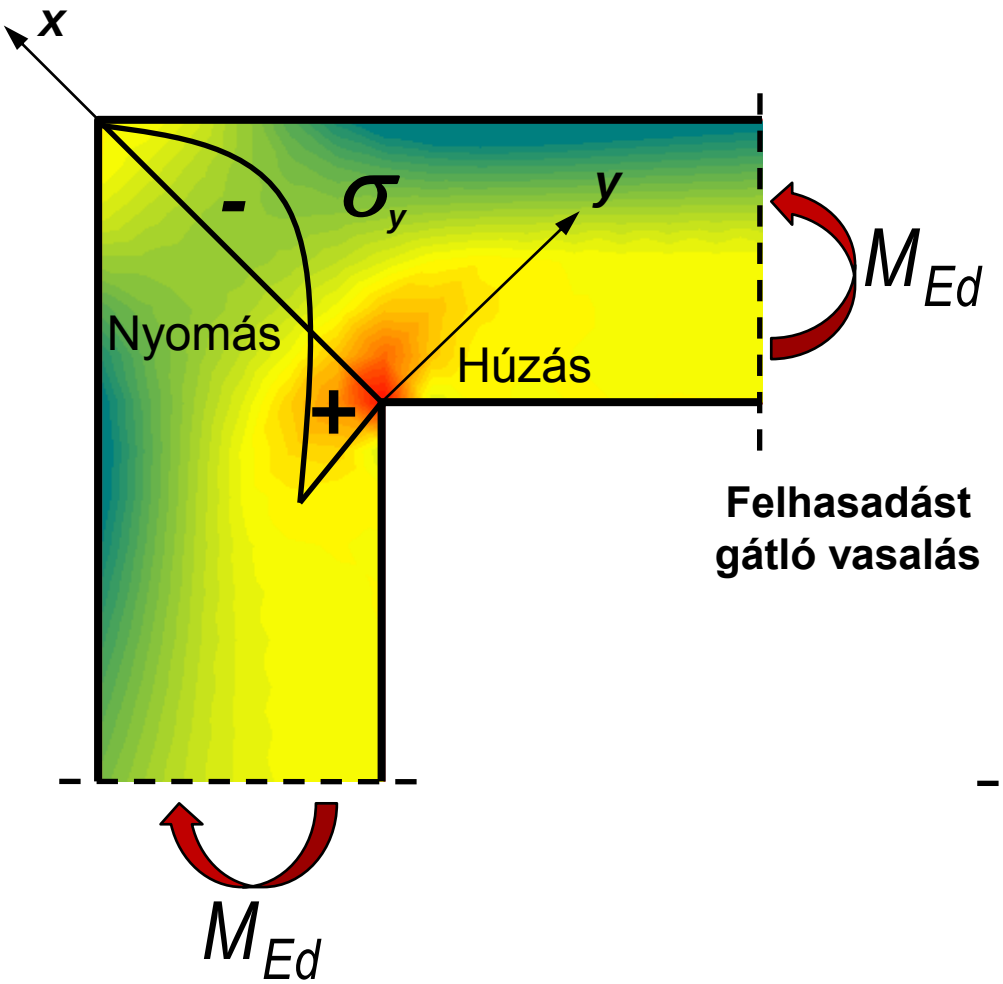
Reinforcing detail of an opening RC frame corner

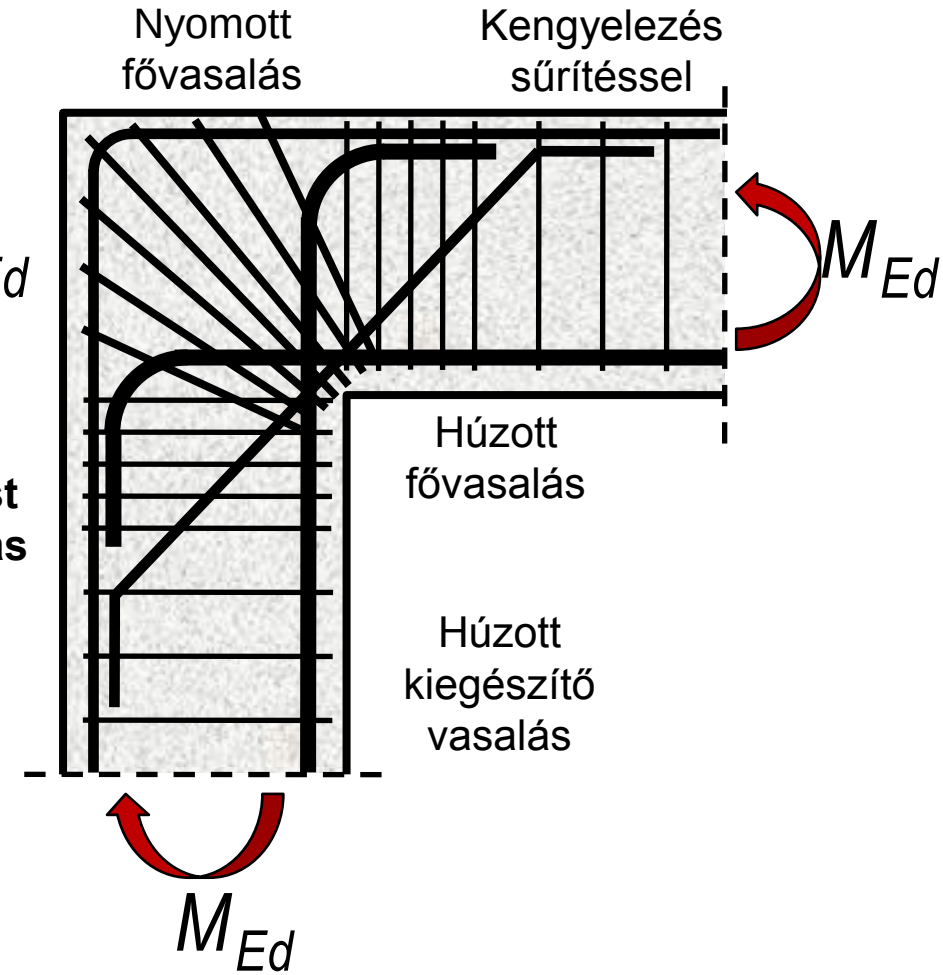
Nyíló vasbeton keretsarok vasvezetése



Reinforcing detail of an opening RC frame corner

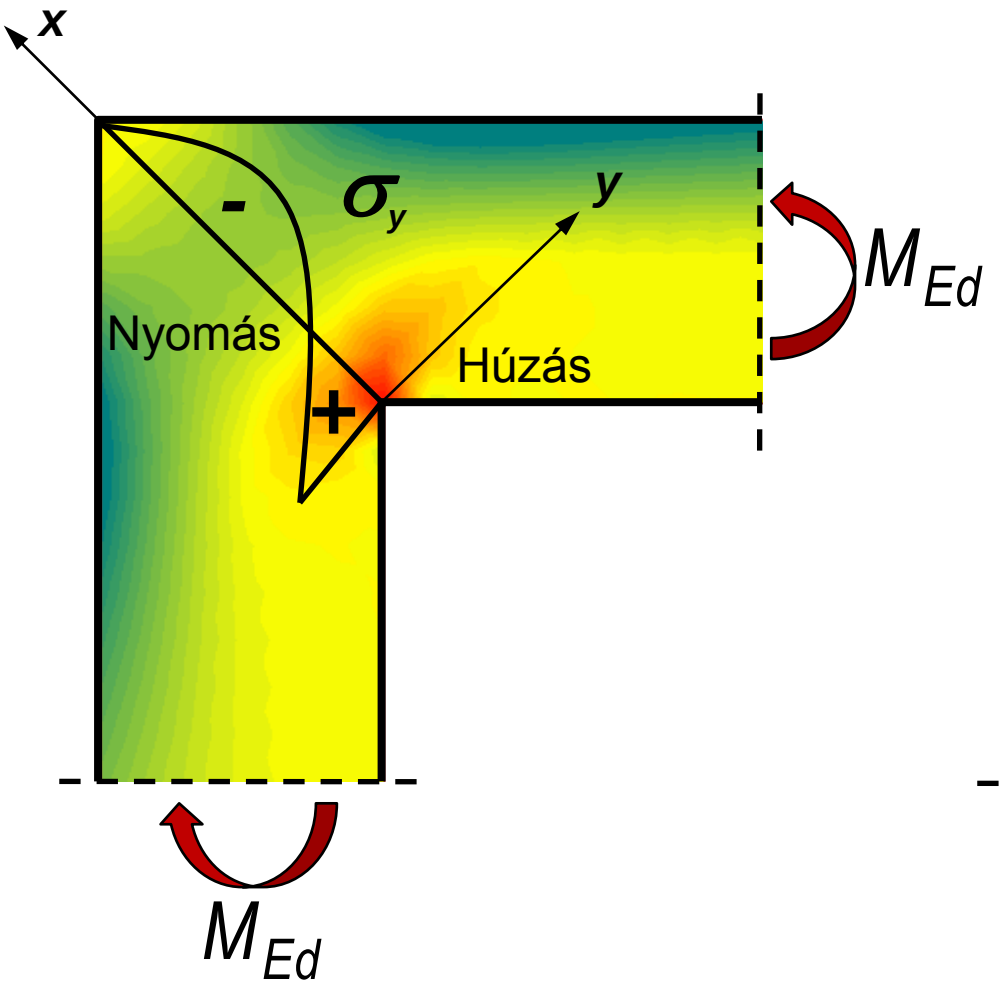
Nyíló vasbeton keretsarok vasvezetése

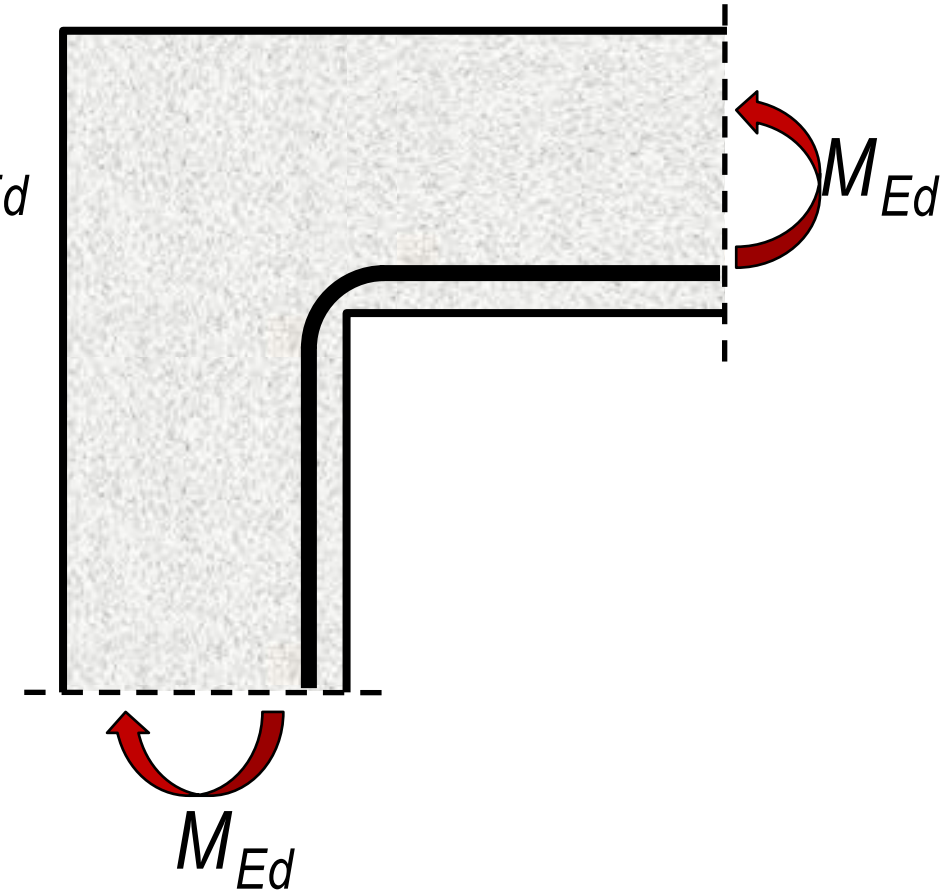




Bearing capacity of an opening RC frame corner I.

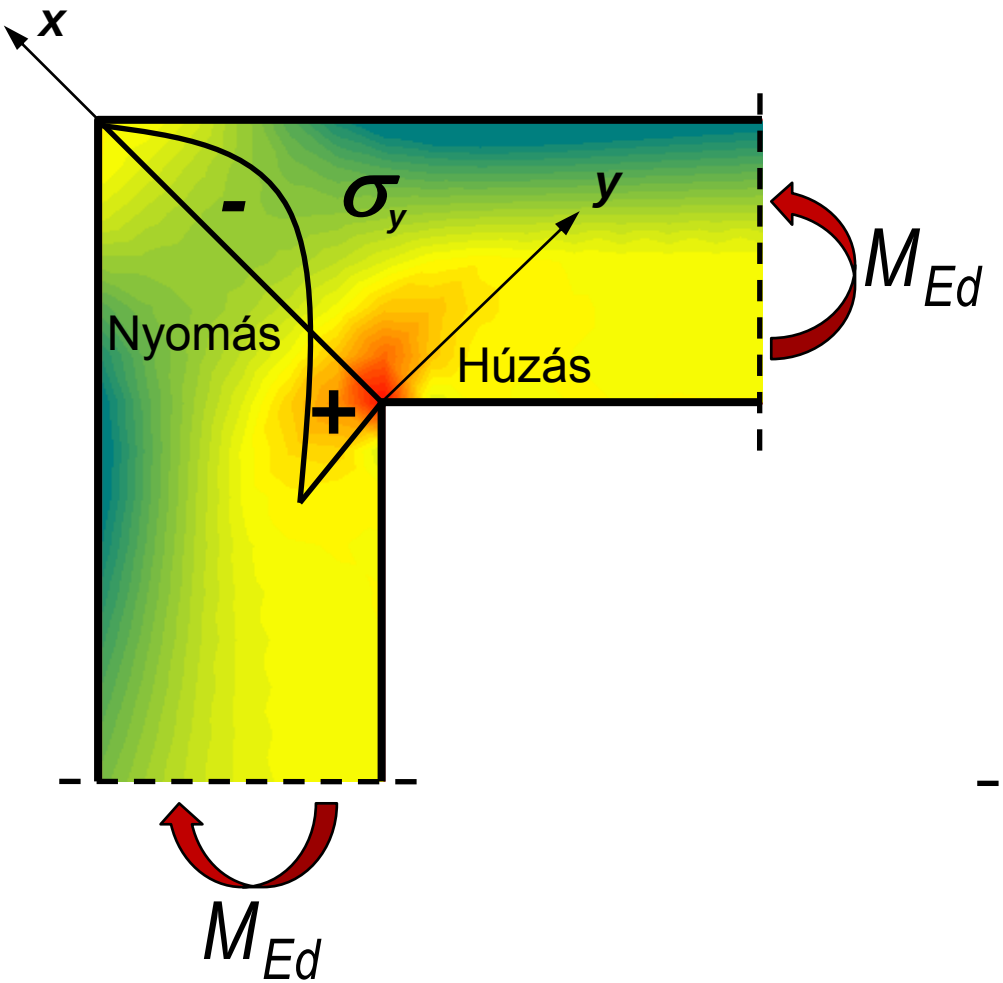
Nyíló vasbeton keretsarok teherbírása I.

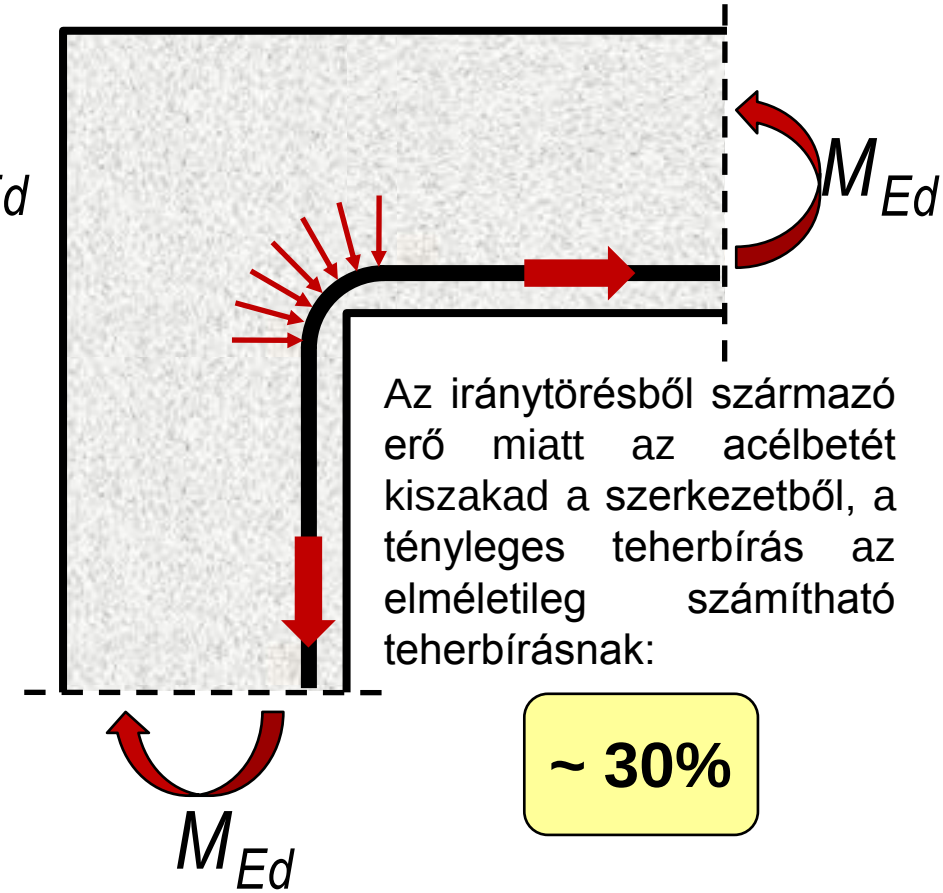




Bearing capacity of an opening RC frame corner I.

Nyíló vasbeton keretsarok teherbírása I.



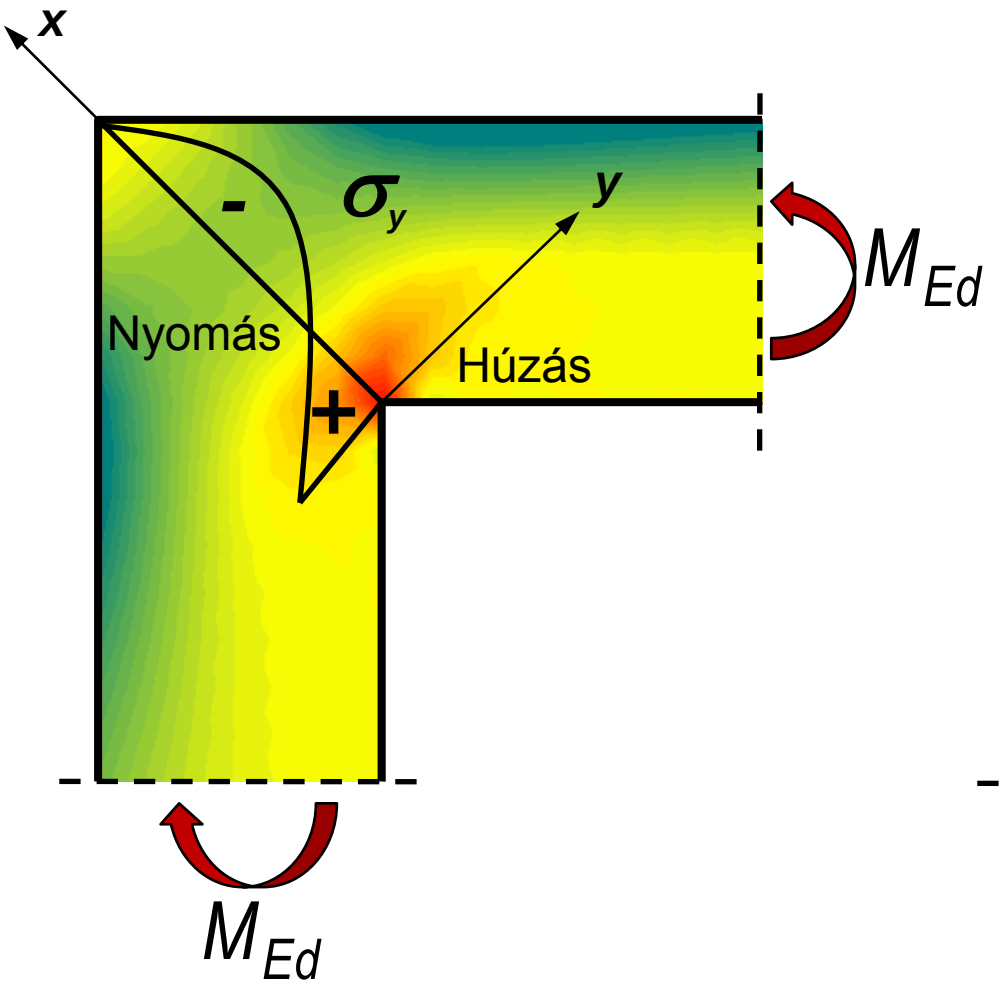


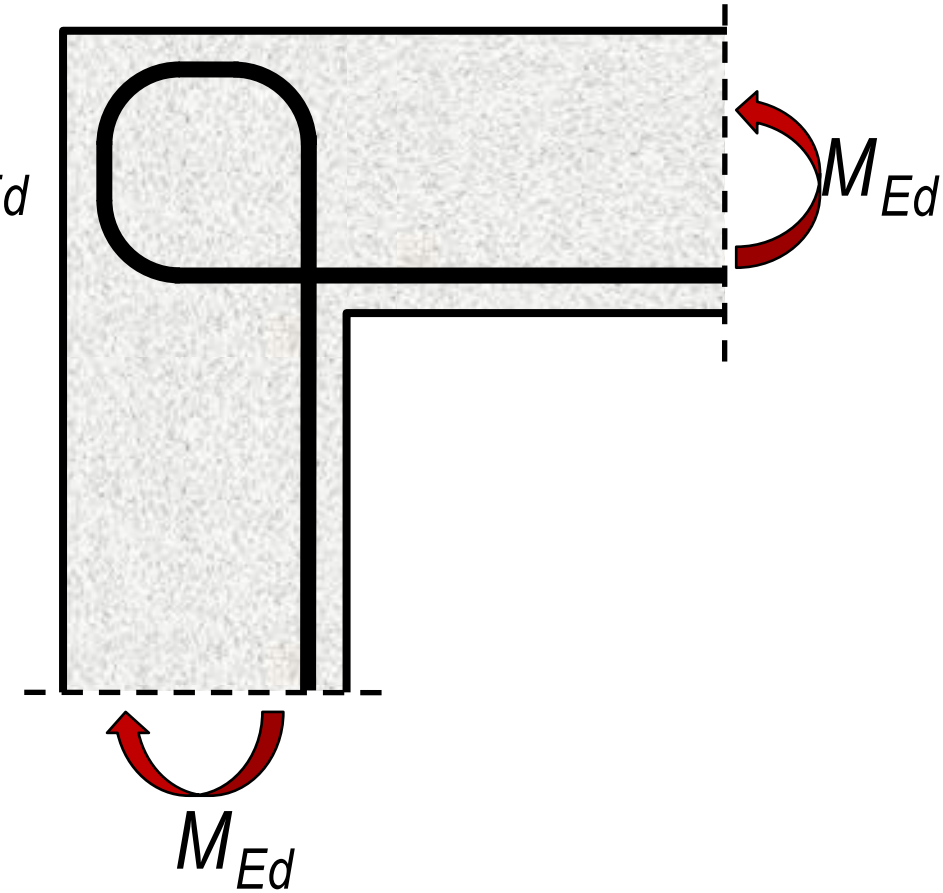
Az iránytörésből származó erő miatt az acélbetét kiszakad a szerkezetből, a tényleges teherbírás az elméletileg számítható teherbírásnak:

~ 30%

Bearing capacity of an opening RC frame corner II.

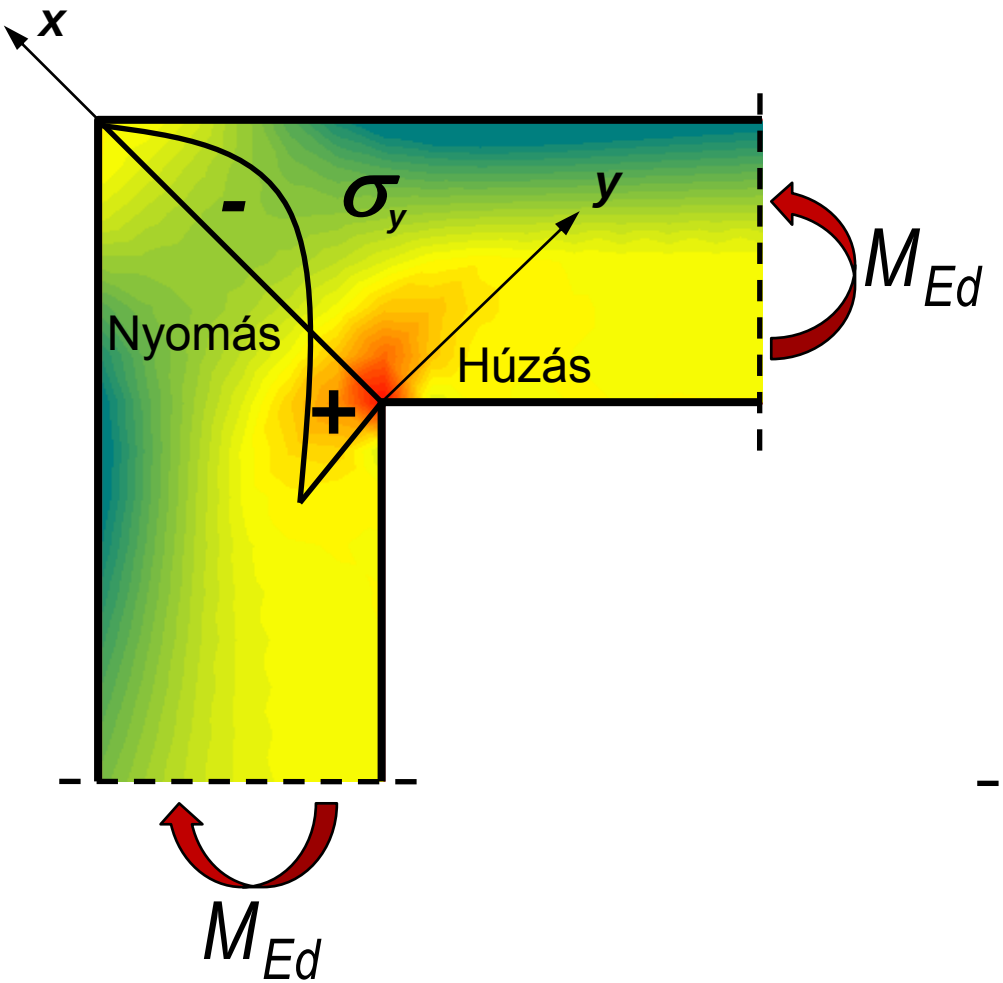
Nyíló vasbeton keretsarok teherbírása II.

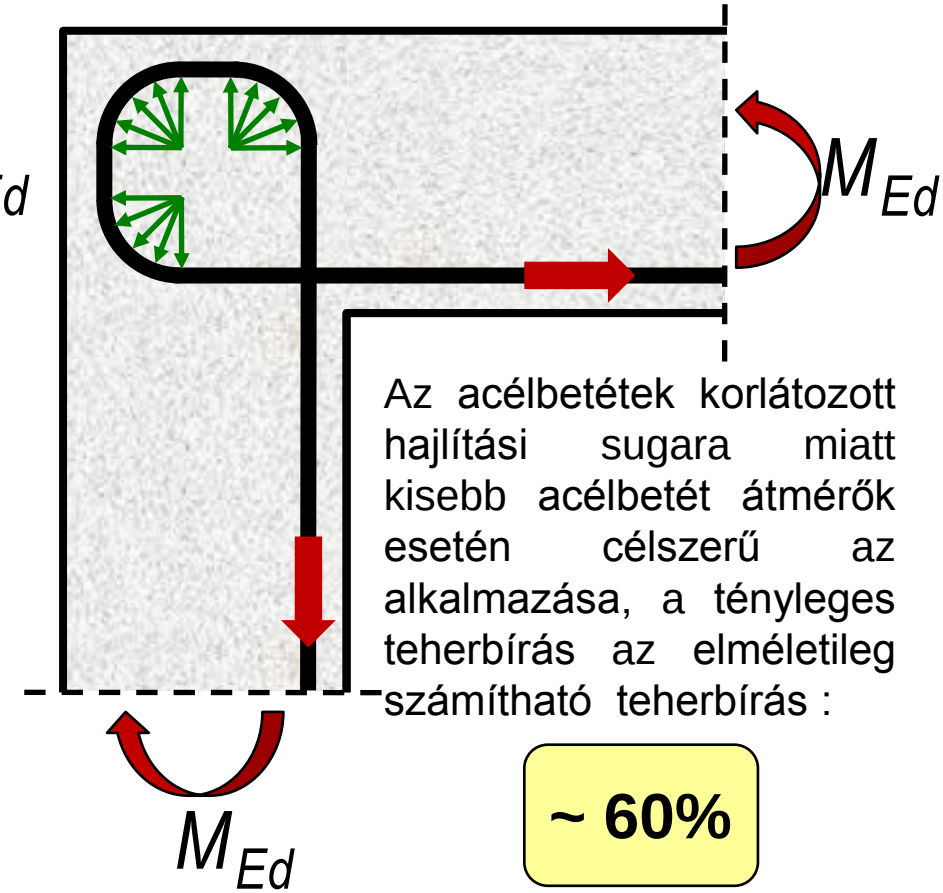




Bearing capacity of an opening RC frame corner II.

Nyíló vasbeton keretsarok teherbírása II.



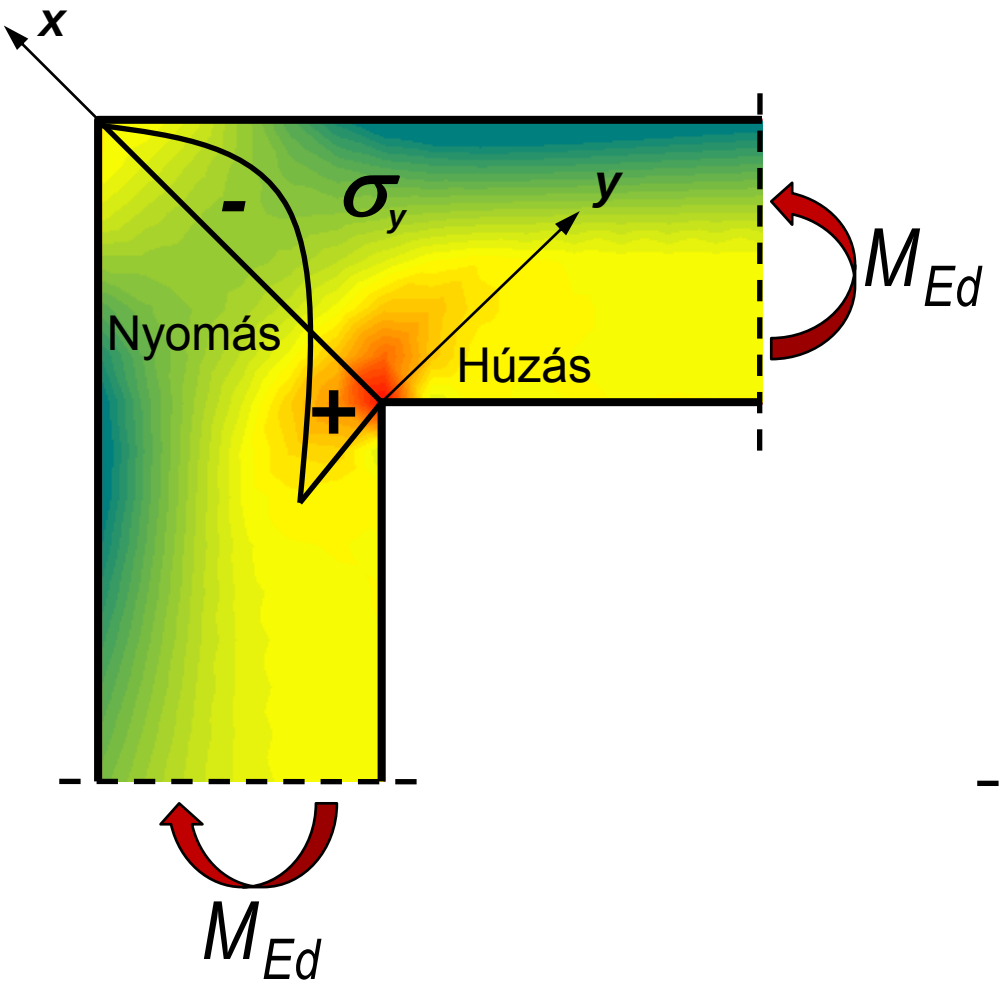


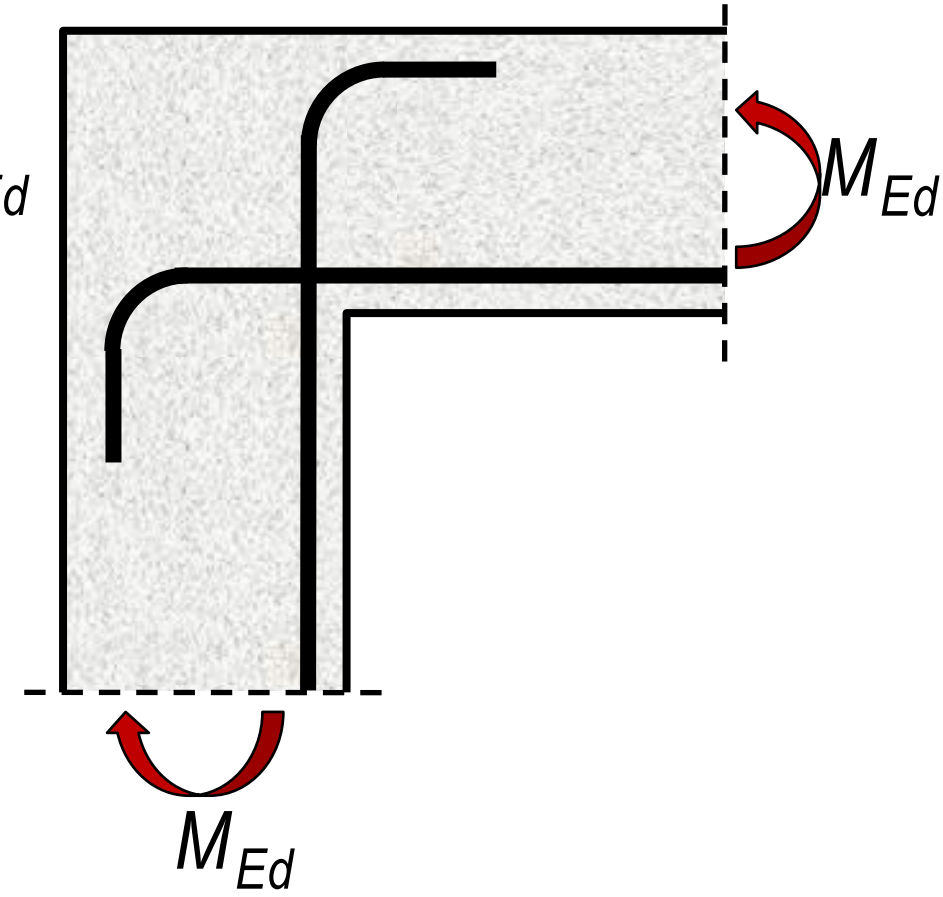
Az acélbetétek korlátozott hajlítási sugara miatt kisebb acélbetét átmérők esetén célszerű az alkalmazása, a tényleges teherbírás az elméletileg számítható teherbírás :

~ 60%

Bearing capacity of an opening RC frame corner III.

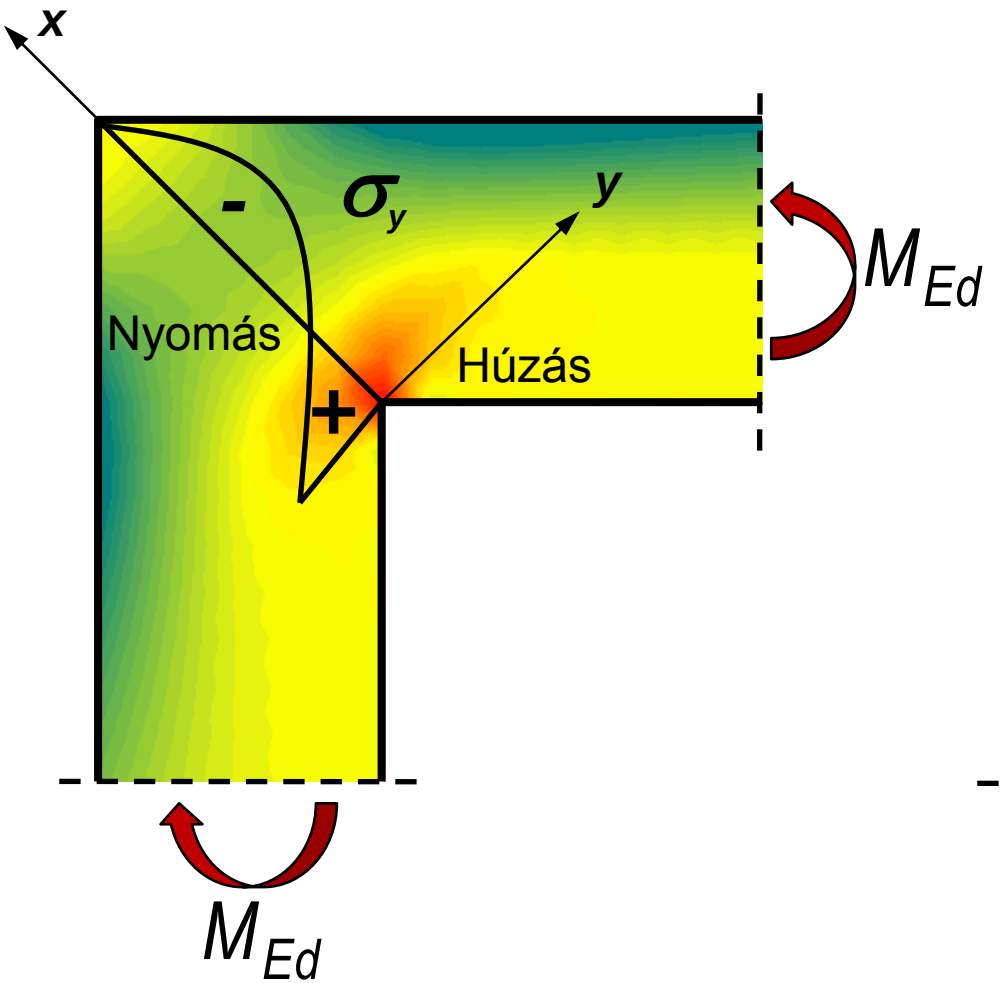
Nyíló vasbeton keretsarok teherbírása III.

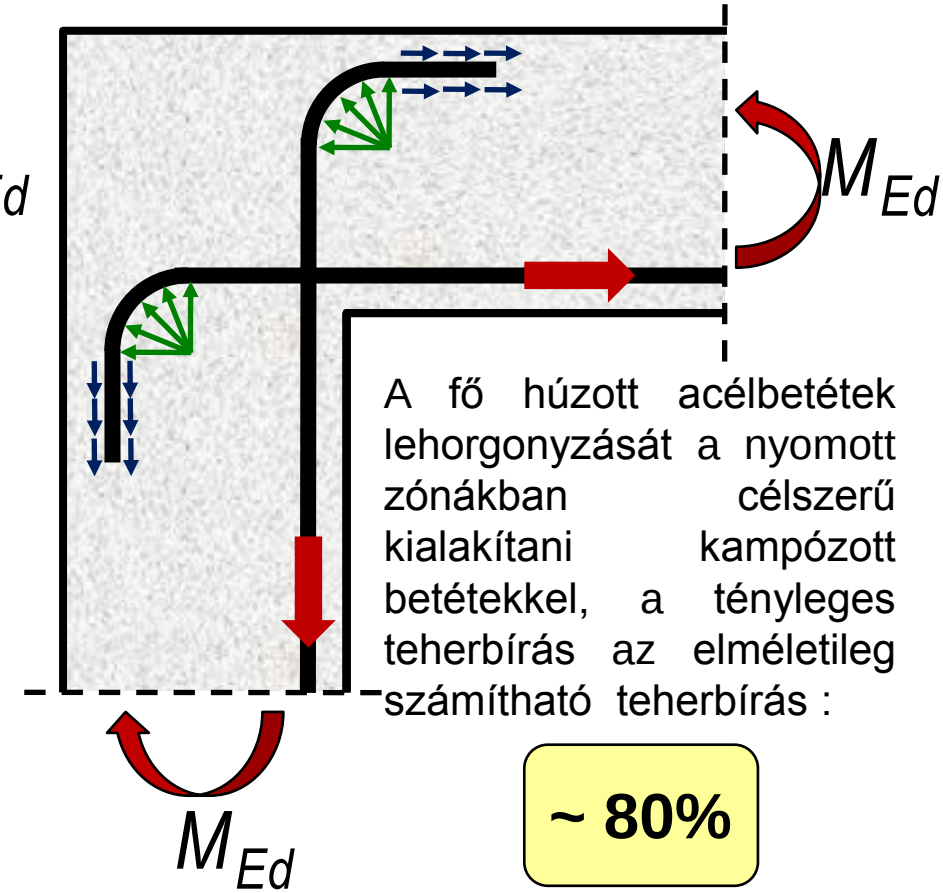




Bearing capacity of an opening RC frame corner III.

Nyíló vasbeton keretsarok teherbírása III.



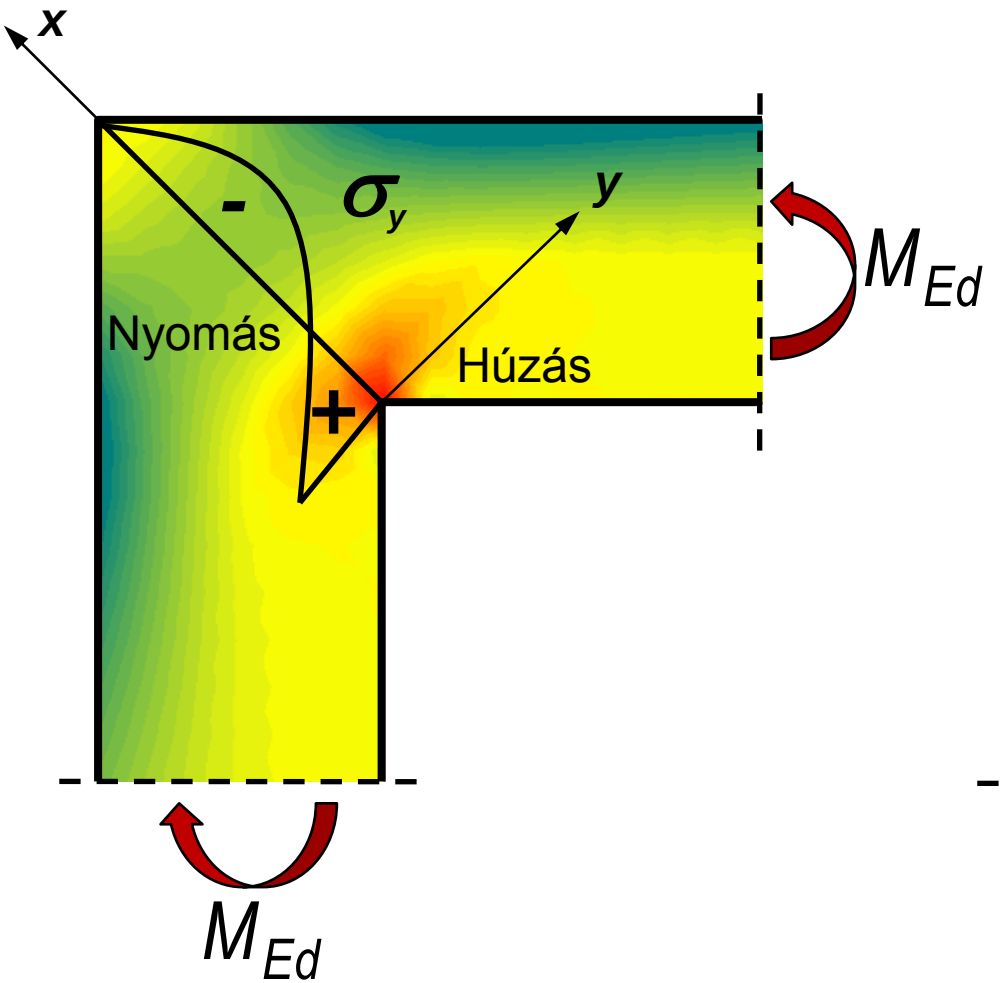


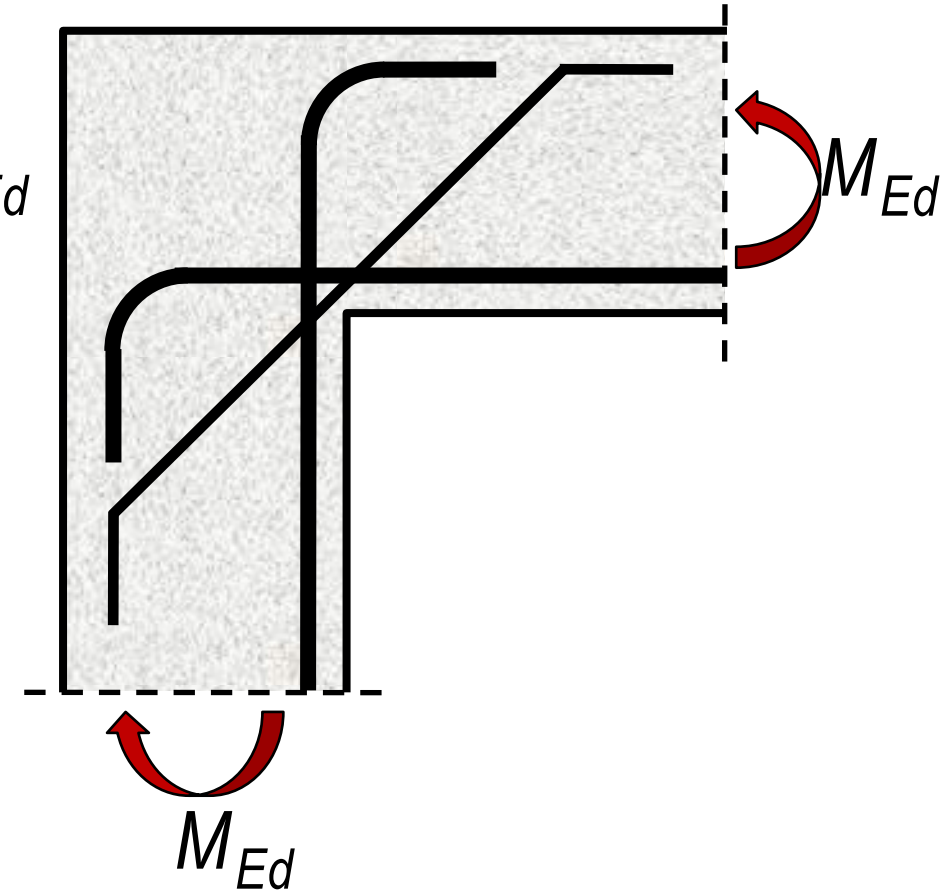
A fő húzott acélbetétek lehorgonyzását a nyomott zónákban célszerű kialakítani kampózott betétekkel, a tényleges teherbírás az elméletileg számítható teherbírás :

~ 80%

Bearing capacity of an opening RC frame corner IV.

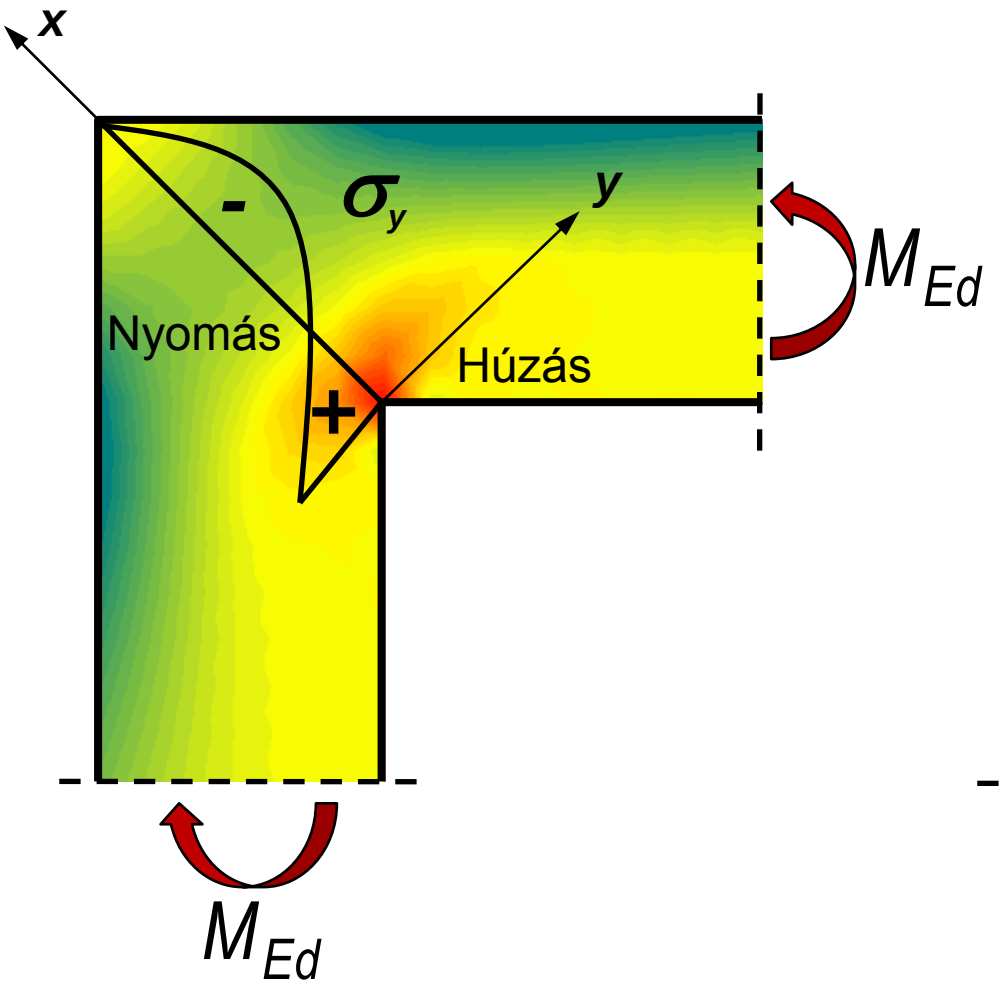
Nyíló vasbeton keretsarok teherbírása IV.

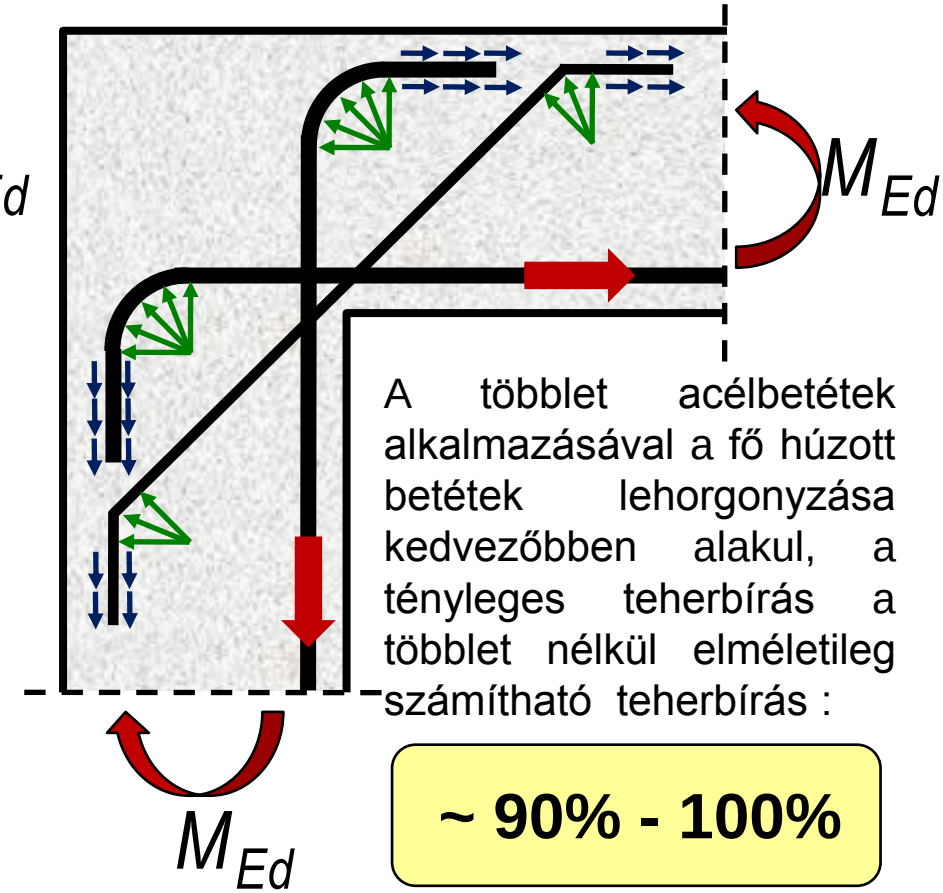




Bearing capacity of an opening RC frame corner IV.

Nyíló vasbeton keretsarok teherbírása IV.



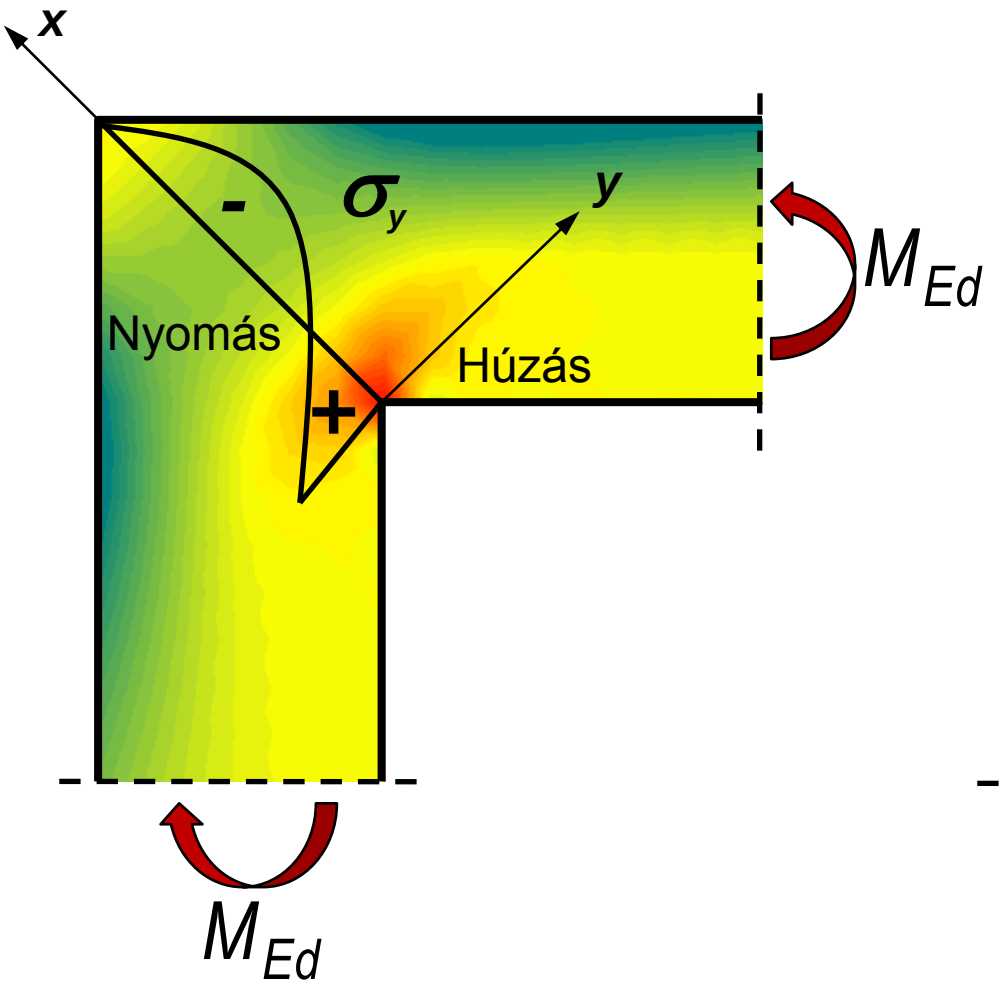


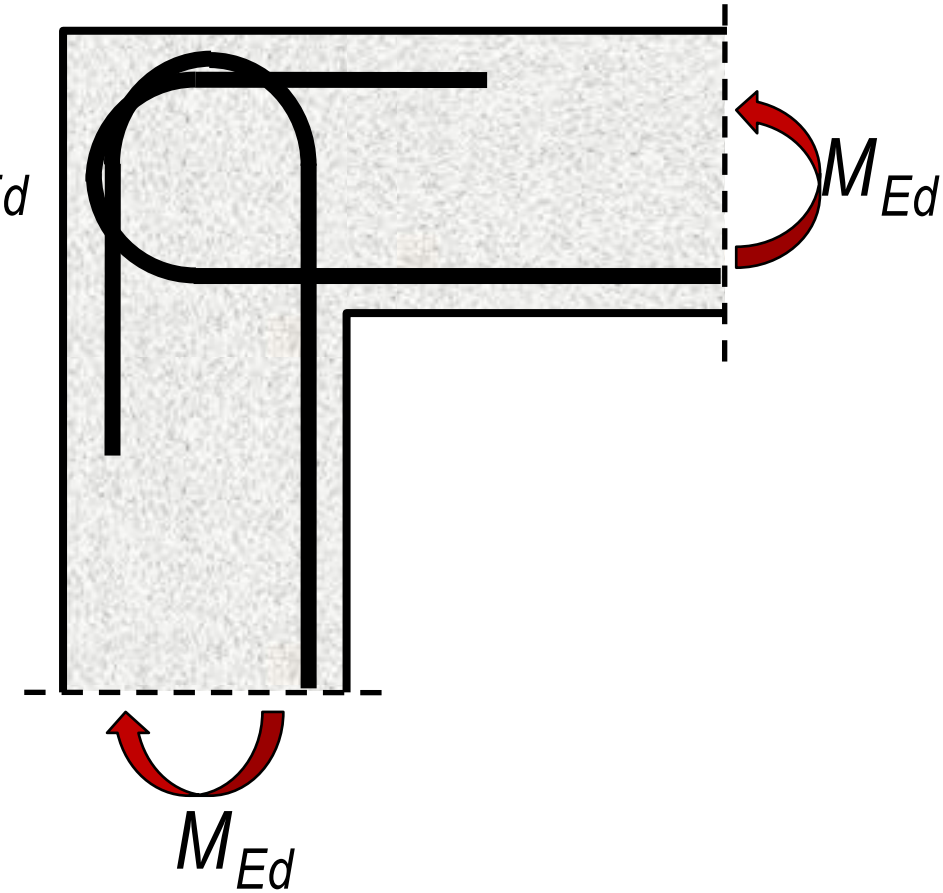
A többlet acélbetétek alkalmazásával a fő húzott betétek lehorgonyzása kedvezőbben alakul, a tényleges teherbírás a többlet nélkül elméletileg számítható teherbírás :

~ 90% - 100%

Bearing capacity of an opening RC frame corner V.

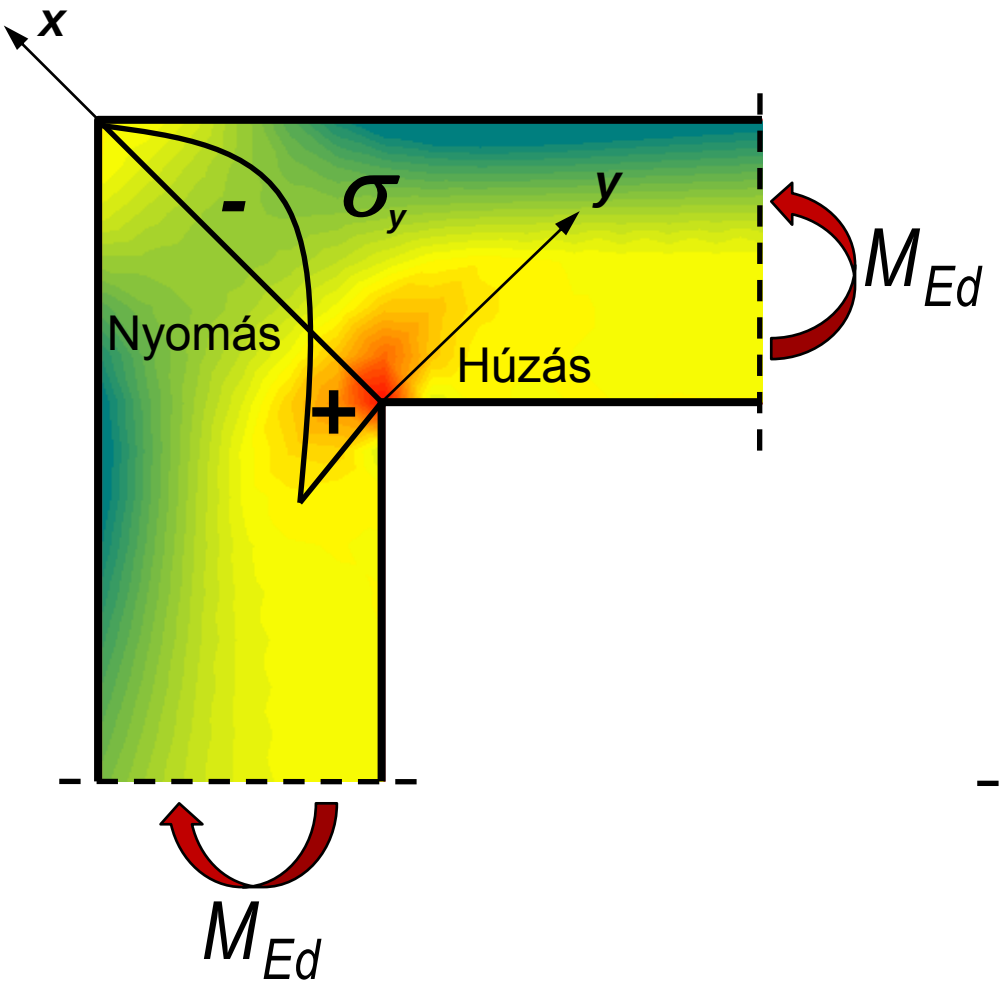
Nyíló vasbeton keretsarok teherbírása V.

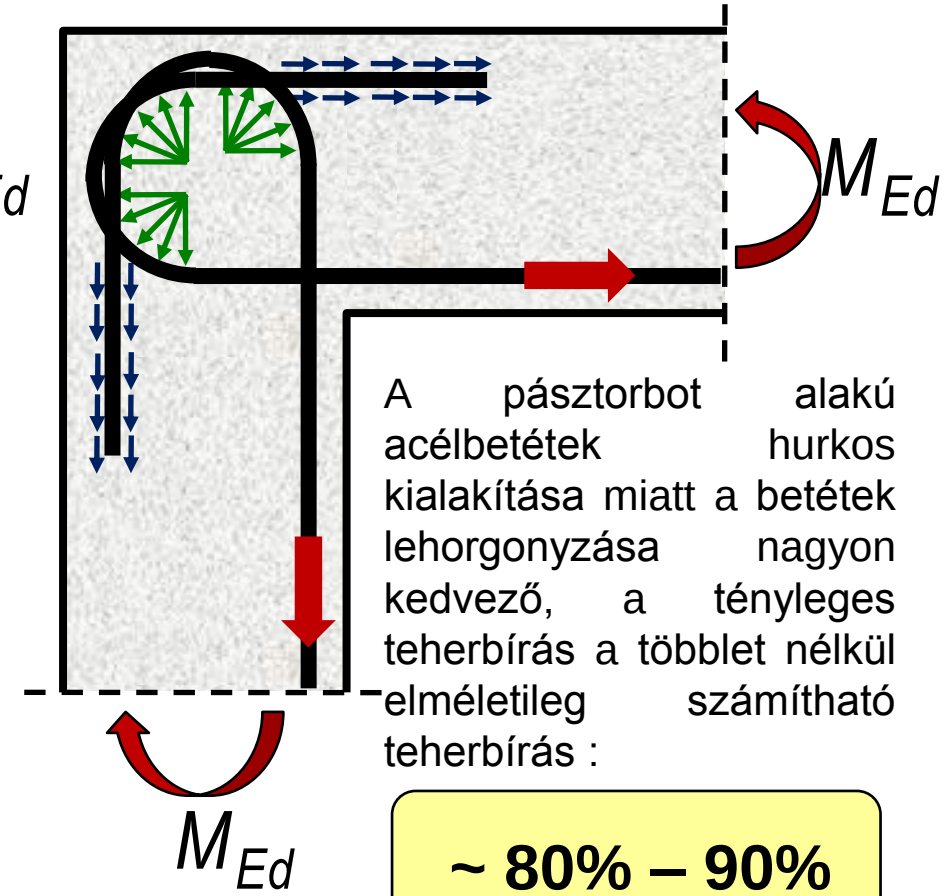




Bearing capacity of an opening RC frame corner V.

Nyíló vasbeton keretsarok teherbírása V.



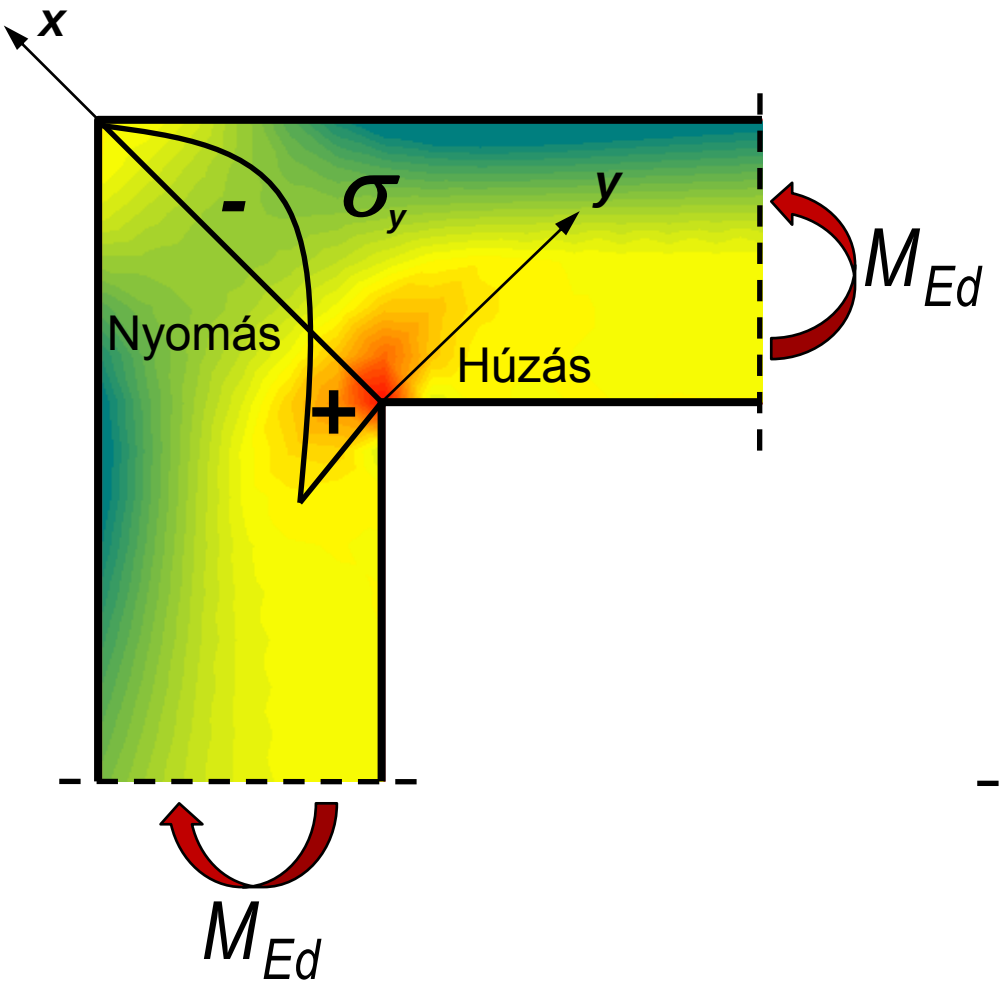


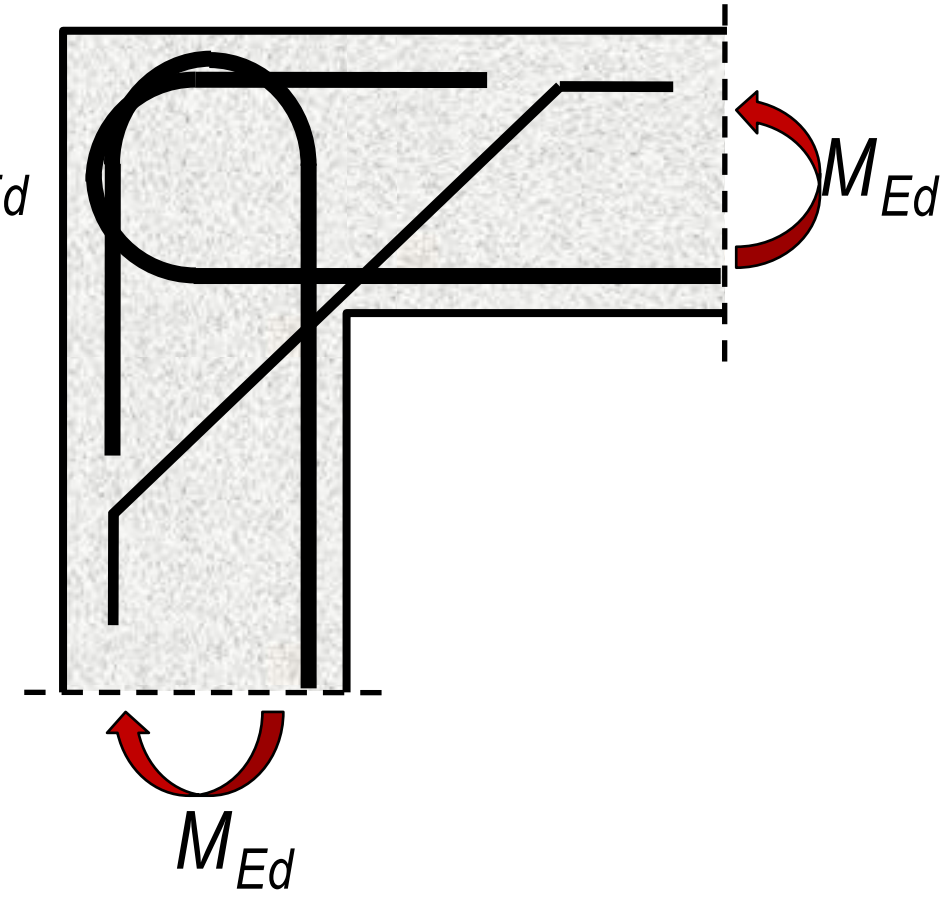
A pásztorbot alakú acélbetétek hurkos kialakítása miatt a betétek lehorgonyzása nagyon kedvező, a tényleges teherbírás a többlet nélkül elméletileg számítható teherbírás :

~ 80% – 90%

Bearing capacity of an opening RC frame corner VI.

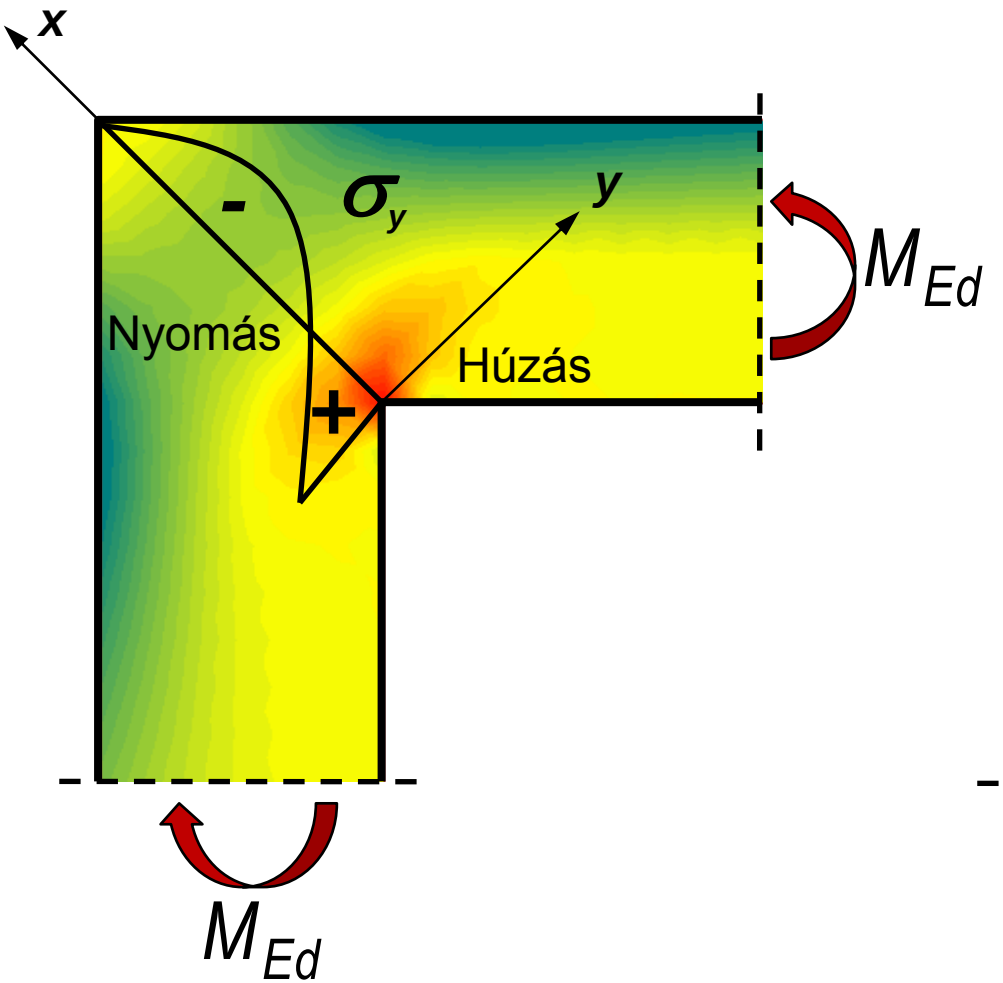
Nyíló vasbeton keretsarok teherbírása VI.

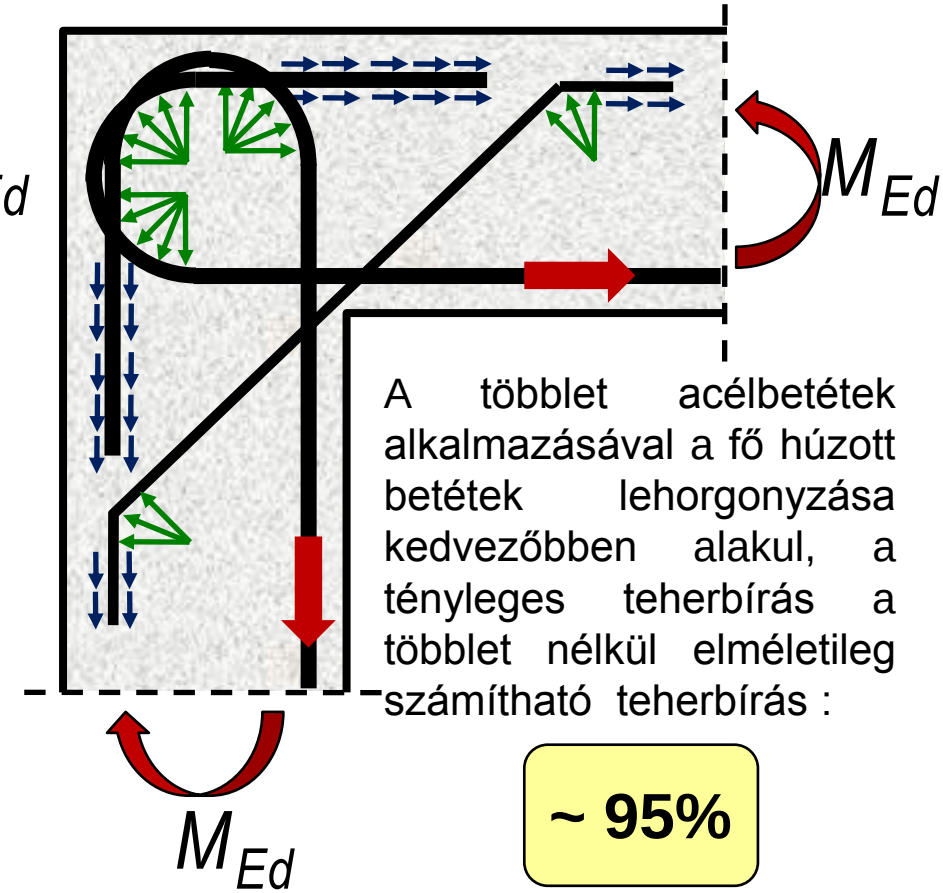




Bearing capacity of an opening RC frame corner VI.

Nyíló vasbeton keretsarok teherbírása VI.



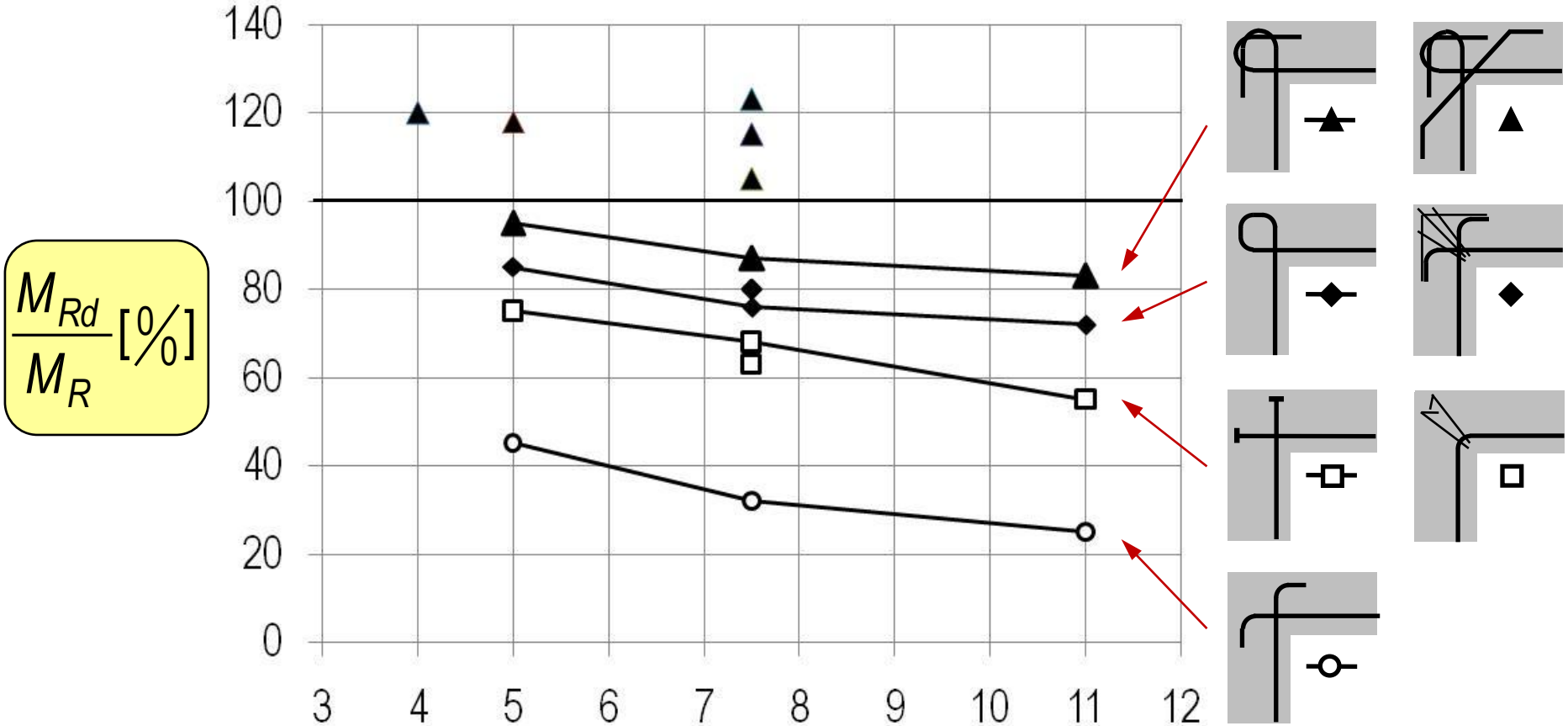


A többlet acélbetétek alkalmazásával a fő húzott betétek lehorgonyzása kedvezőbben alakul, a tényleges teherbírás a többlet nélkül elméletileg számítható teherbírás :

~ 95%

Bearing capacity of opening RC frame corners – experimental results

Nyíló vasbeton keretsarkok teherbírása – kísérleti megfigyelések

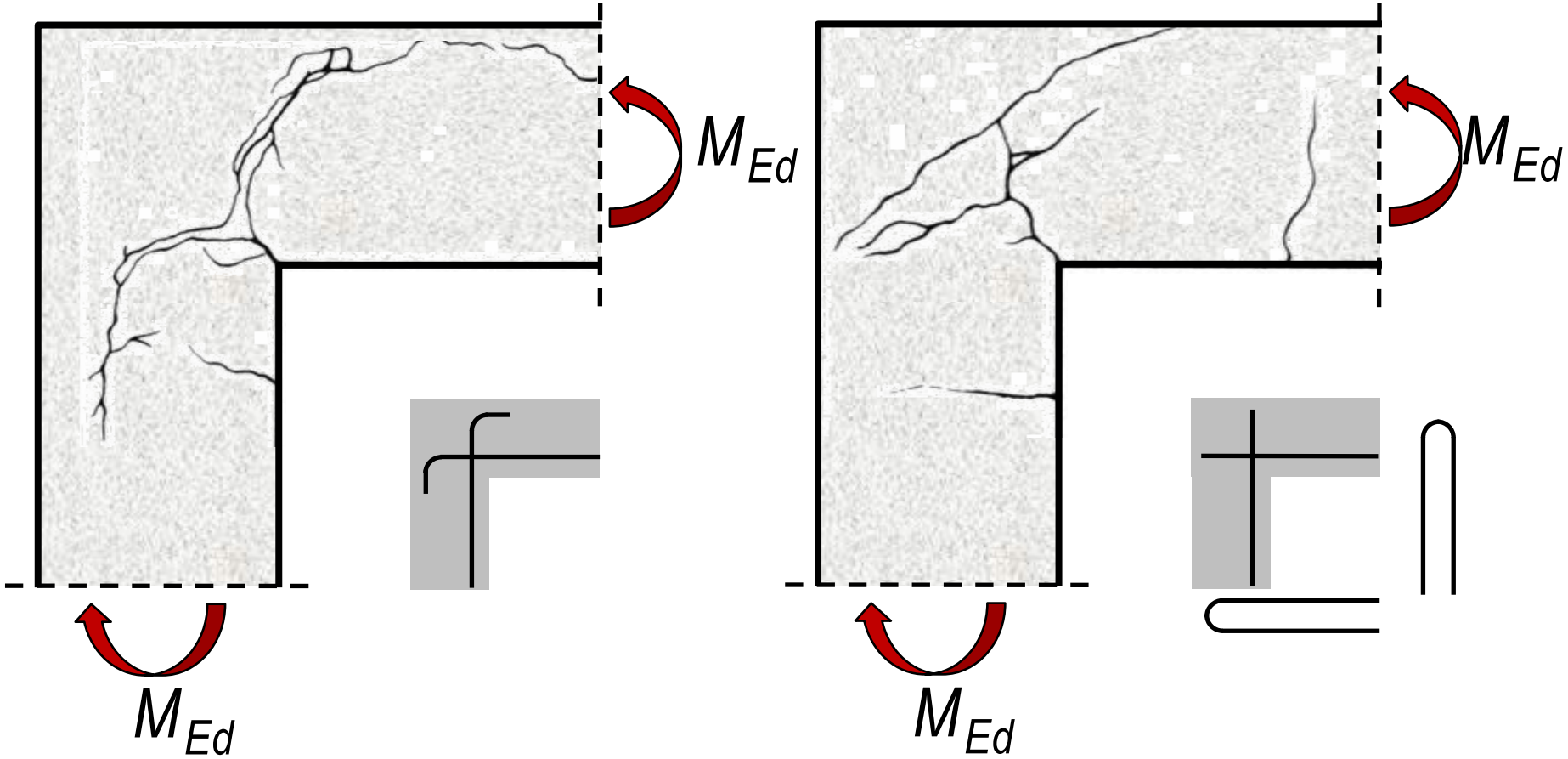


$$\rho = \frac{A_{s,prov}}{b \cdot d}[‰]$$

Leonhardt, F.: Vorlesungen über Massivbau, Grundlagen zur Bemessung im Stahlbetonbau. Auflage 1990, Springer-Verlag, Berlin/Heidelberg/New York. alapján

Bearing capacity of opening RC frame corners – experimental results

Nyíló vasbeton keretsarkok teherbírása – kísérleti megfigyelések

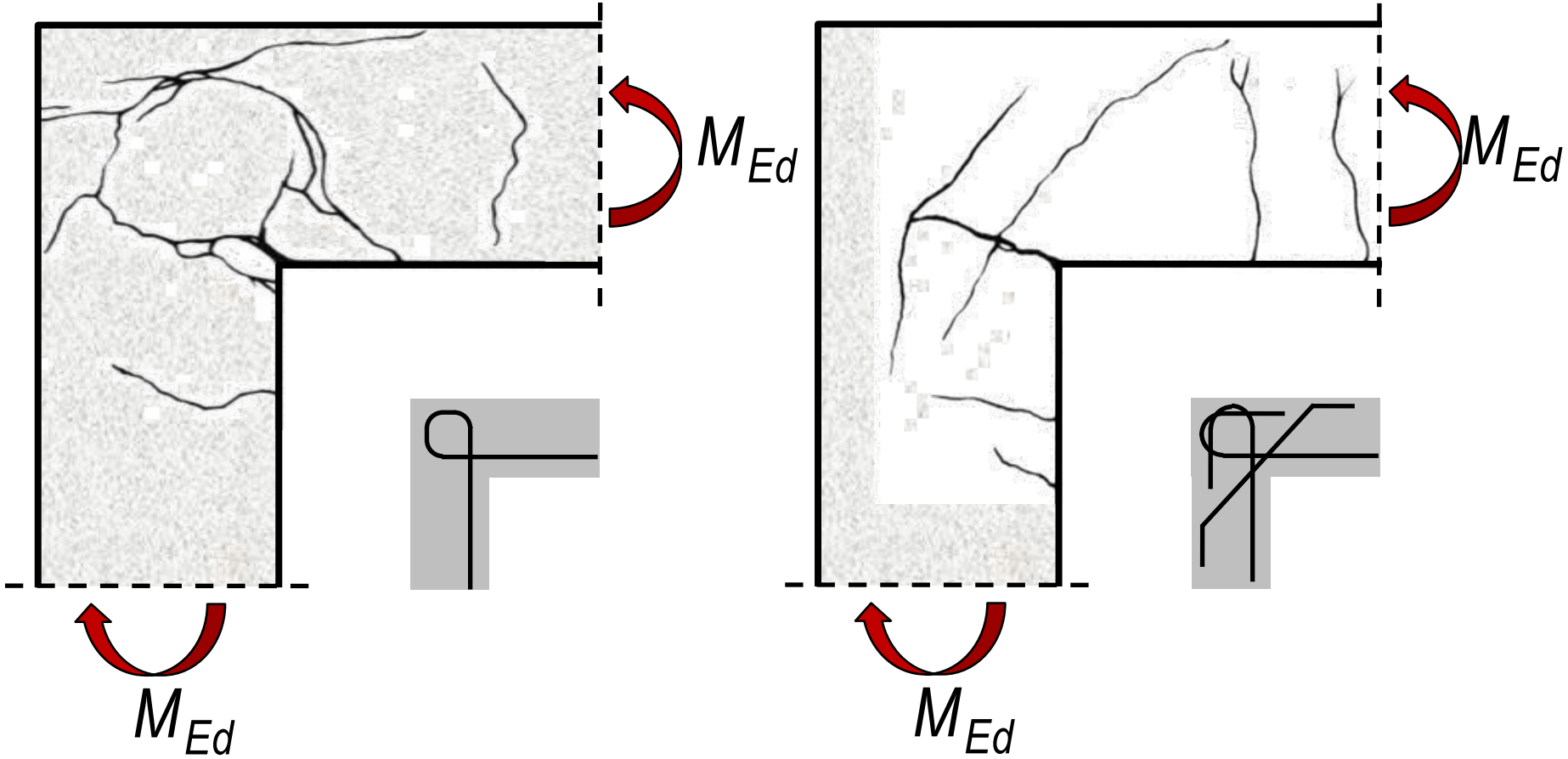


Leonhardt, F.: Vorlesungen über Massivbau, Grundlagen zur Bemessung im Stahlbetonbau. Auflage 1990, Springer-Verlag, Berlin/Heidelberg/New York. alapján

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Bearing capacity of opening RC frame corners – experimental results

Nyíló vasbeton keretsarkok teherbírása – kísérleti megfigyelések



Leonhardt, F.: Vorlesungen über Massivbau, Grundlagen zur Bemessung im Stahlbetonbau. Auflage 1990, Springer-Verlag, Berlin/Heidelberg/New York. alapján

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

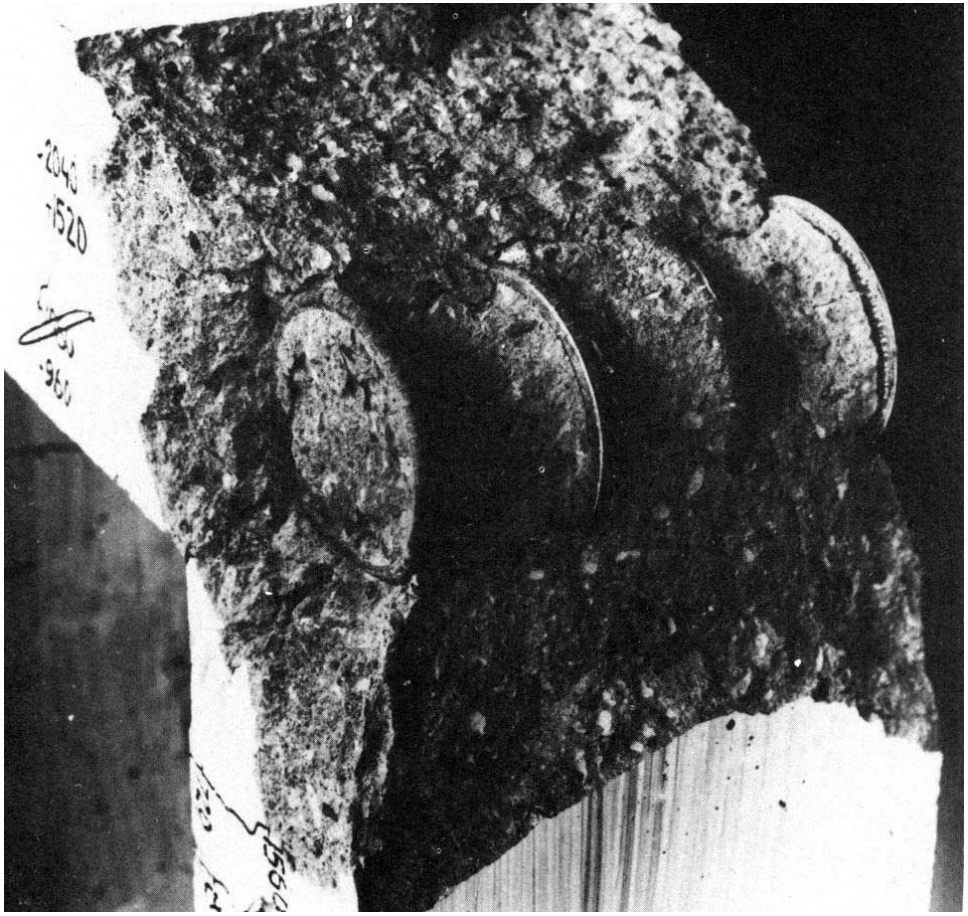
Failure pattern of an opening RC frame corners

Nyíló vasbeton keretsarok törésképe

Akkermann, J.: Rotationsverhalten von Stahlbeton-Rahmenecken, Dissertation, Institut für Massivbau und Baustofftechnologie, Universität Karlsruhe 2000.

Failure pattern of an opening RC frame corners

Nyíló vasbeton keretsarok törésképe



Leonhardt, F.: Vorlesungen über Massivbau, Grundlagen zur Bemessung im Stahlbetonbau. Auflage 1990, Springer-Verlag, Berlin/Heidelberg/New York.

Failure pattern of a closing RC frame corners

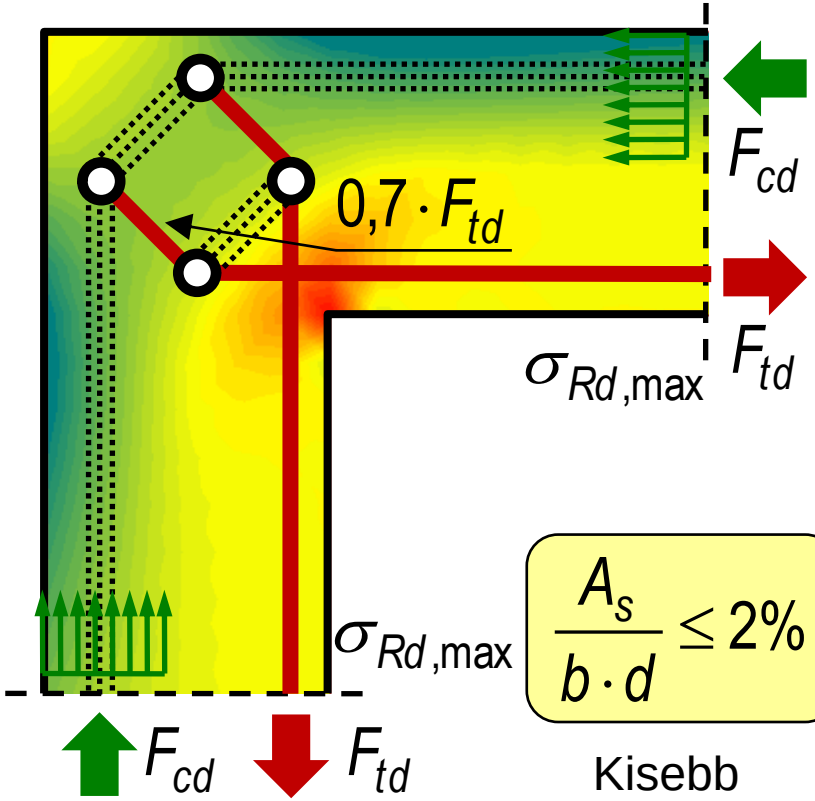
Záródó vasbeton keretsarok törésképe

Akkermann, J.: Rotationsverhalten von Stahlbeton-Rahmenecken, Dissertation, Institut für Massivbau und Baustofftechnologie, Universität Karlsruhe 2000.

Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J3., pp. 207.

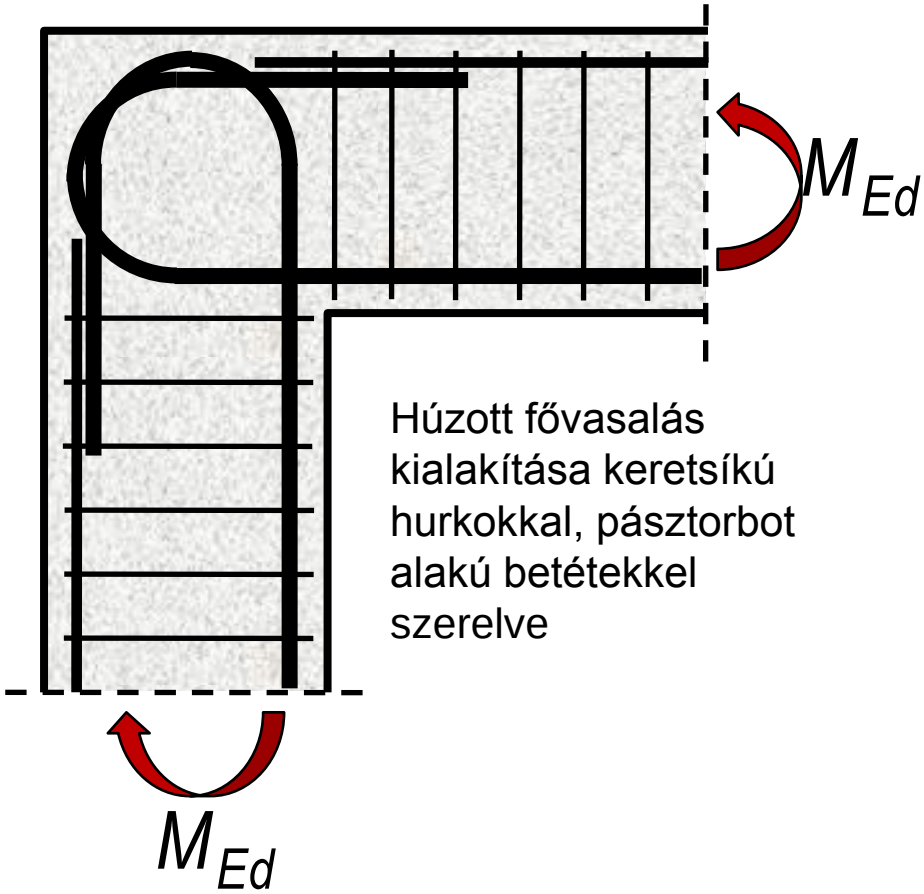
Rácsostartó modell, MSZ EN 1992-1-1:2010, J3. ábra, 207. oldal

Nyíló keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)



$$\frac{A_s}{b \cdot d} \leq 2\%$$

Kisebb saroknyomatékok esetén

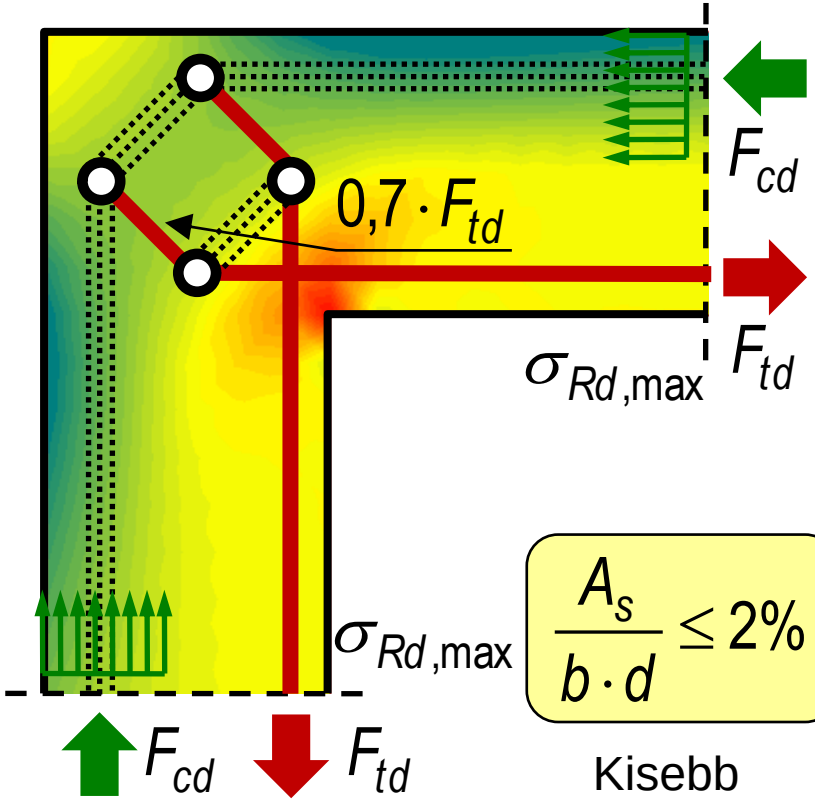


Húzott fővasalás kialakítása keretsíkú hurkokkal, pásztorbot alakú betétekkel szerelve

Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J3., pp. 207.

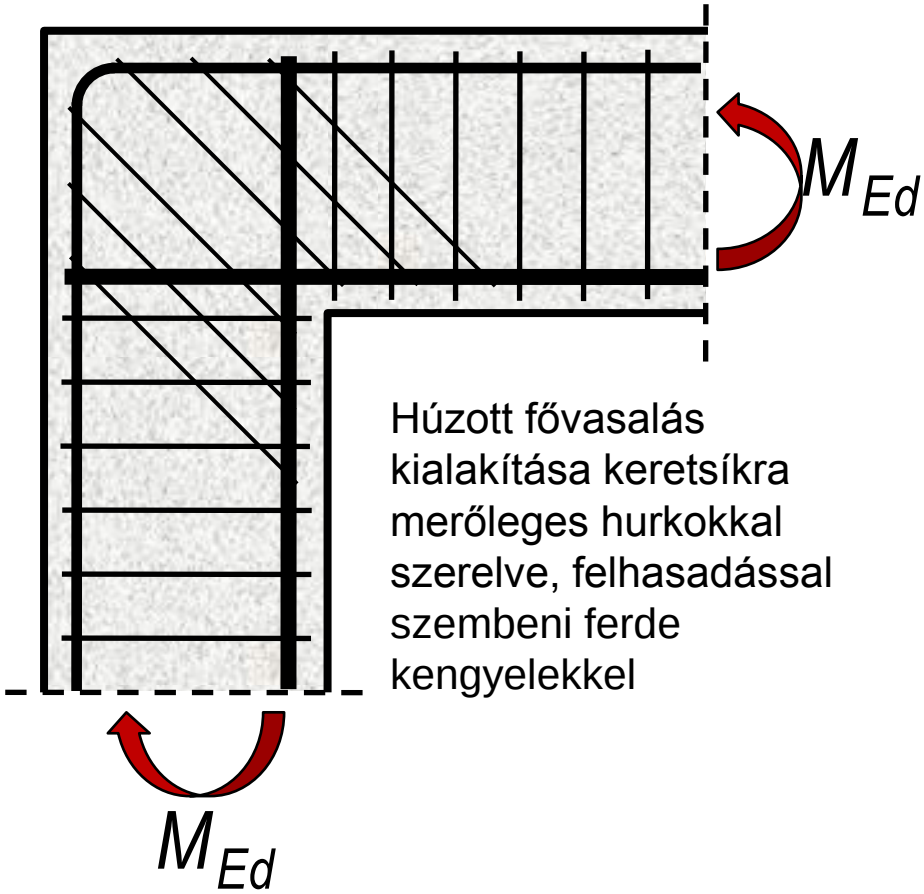
Rácsostartó modell, MSZ EN 1992-1-1:2010, J3. ábra, 207. oldal

Nyíló keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)



$$\frac{A_s}{b \cdot d} \leq 2\%$$

Kisebb saroknyomatékok esetén

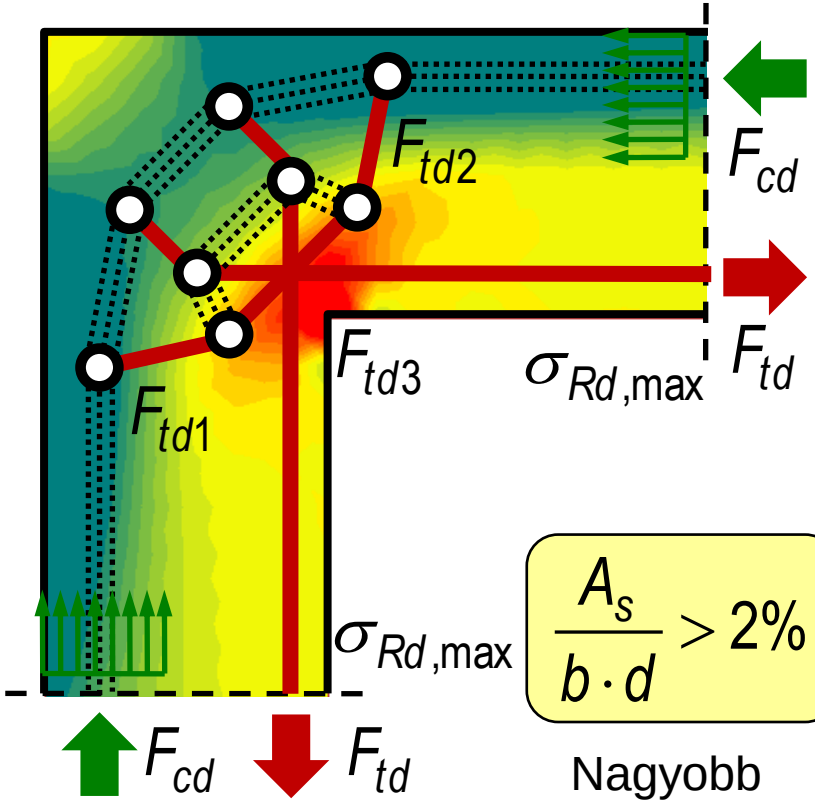


Húzott fővasalás kialakítása keretsíkra merőleges hurkokkal szerelve, felhasadással szembeni ferde kengyelekkel

Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J4., pp. 207.

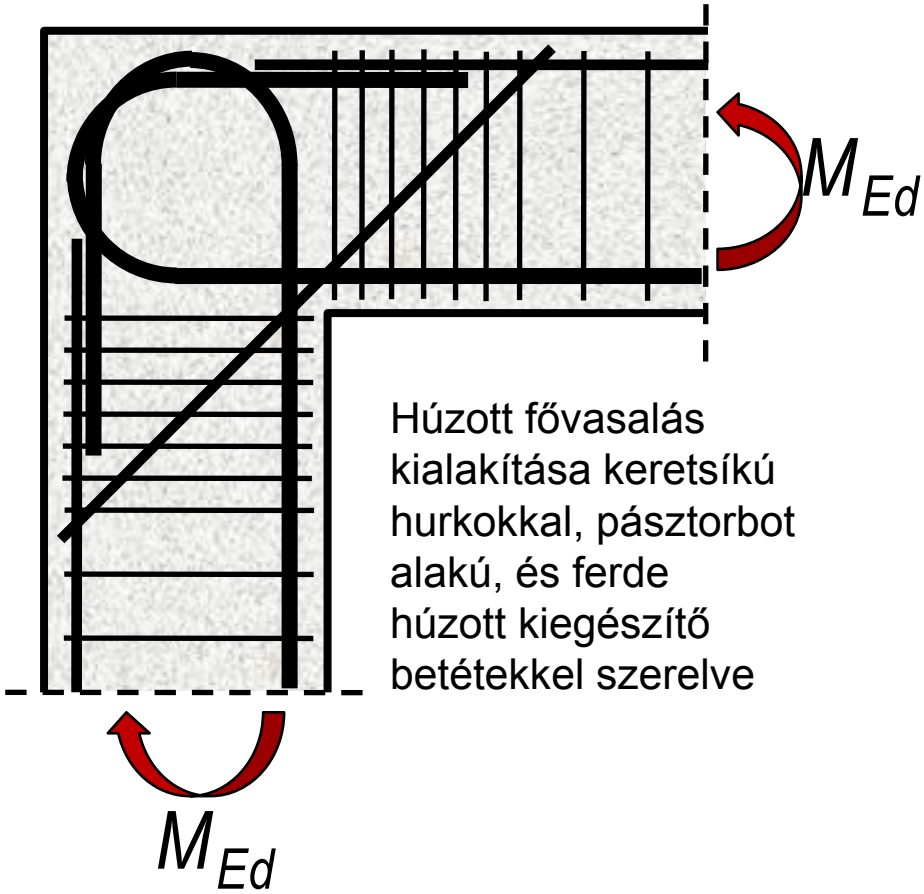
Rácsostartó modell, MSZ EN 1992-1-1:2010, J4. ábra, 207. oldal

Nyíló keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)



$$\frac{A_s}{b \cdot d} > 2\%$$

Nagyobb saroknyomatékok esetén

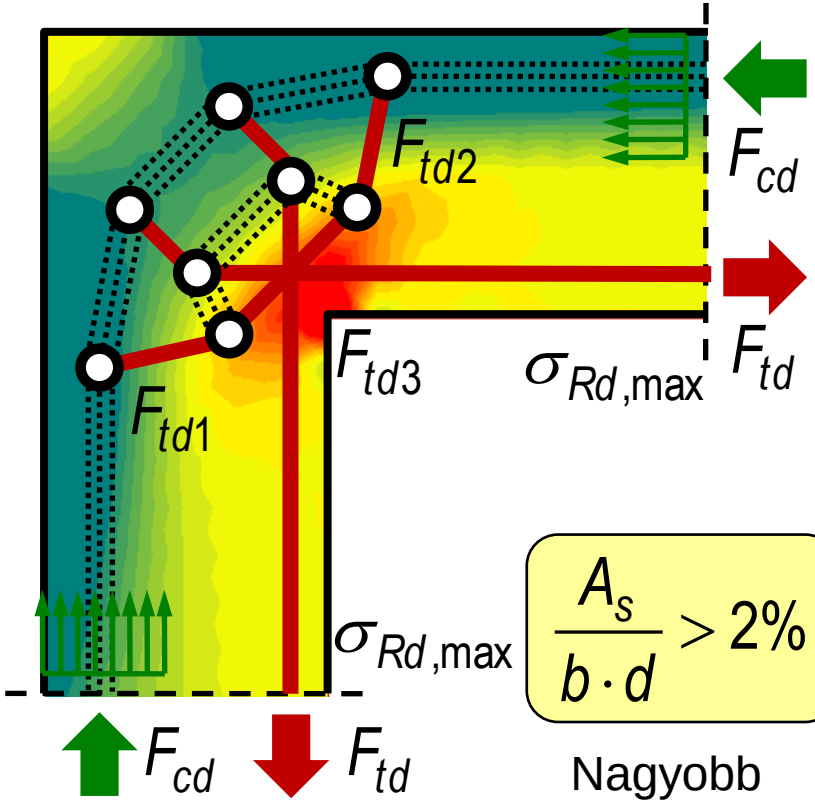


Húzott fővasalás kialakítása keretsíkú hurkokkal, pásztorbot alakú, és ferde húzott kiegészítő betétekkel szerelve

Strut-and-tie modell, MSZ EN 1992-1-1:2010, Fig. J4., pp. 207.

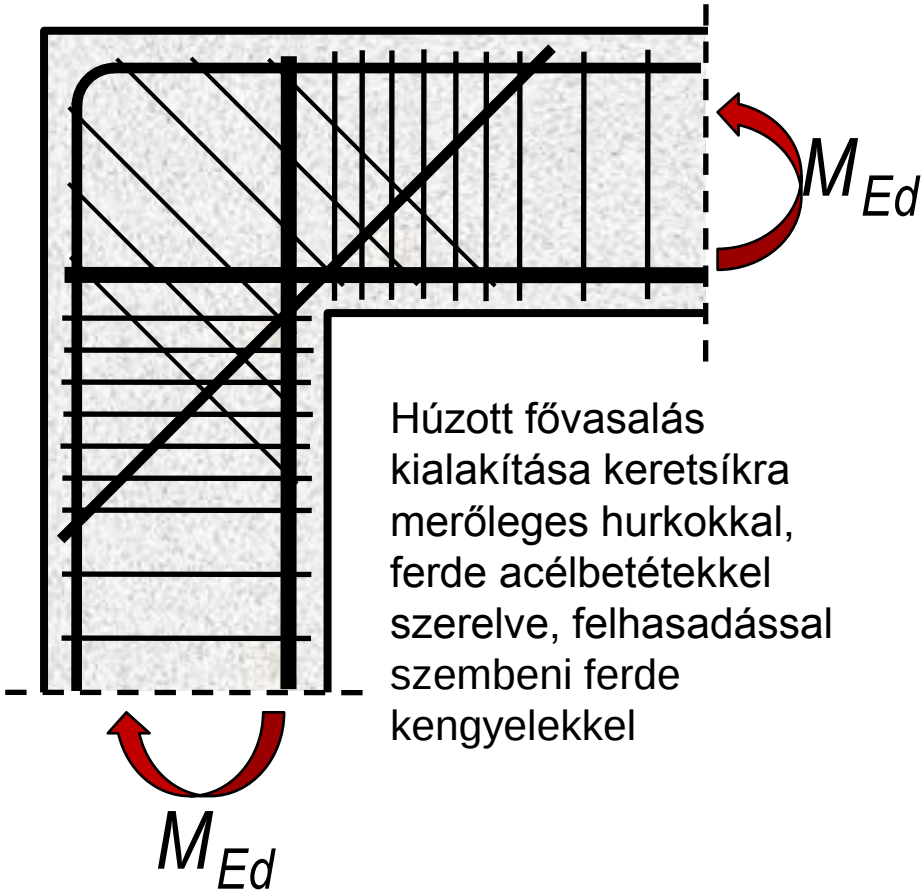
Rácsostartó modell, MSZ EN 1992-1-1:2010, J4. ábra, 207. oldal

Nyíló keretsarok rácsostartó modellje és vasalása (MSZ EN 1992-1-1:2010)



$$\frac{A_s}{b \cdot d} > 2\%$$

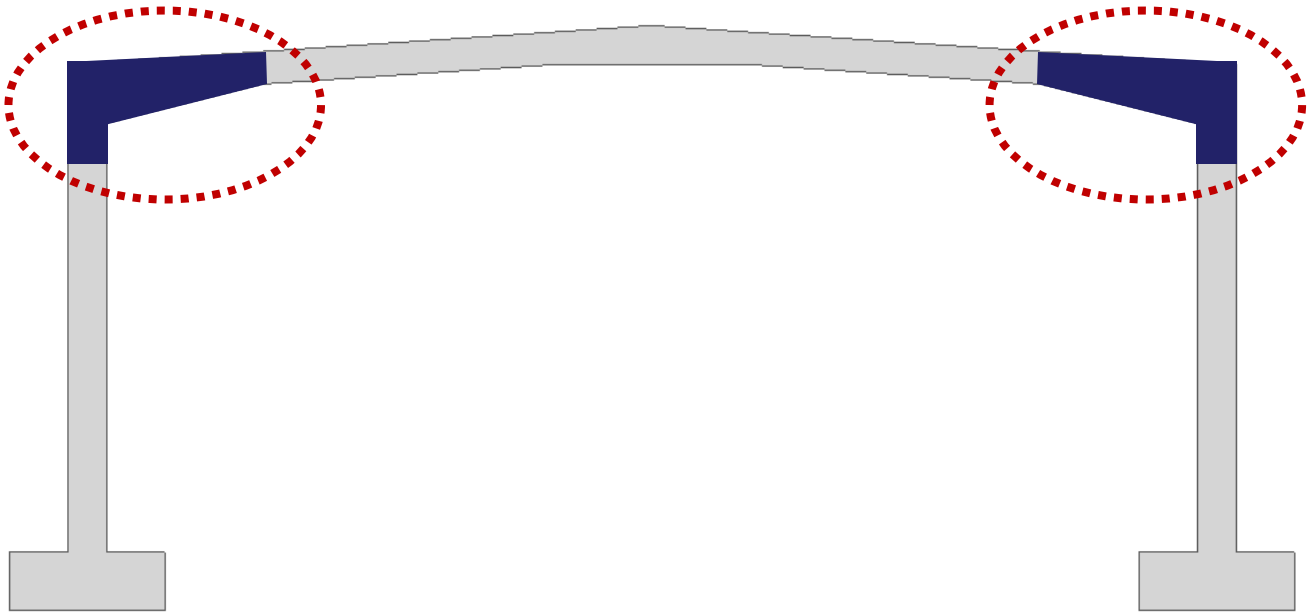
Nagyobb saroknyomatékok esetén



Húzott fővasalás kialakítása keretsíkra merőleges hurkokkal, ferde acélbetétekkel szerelve, felhasadással szembeni ferde kengyelekkel

Enlarged RC frame corner

Kiékelt vasbeton keretsarok

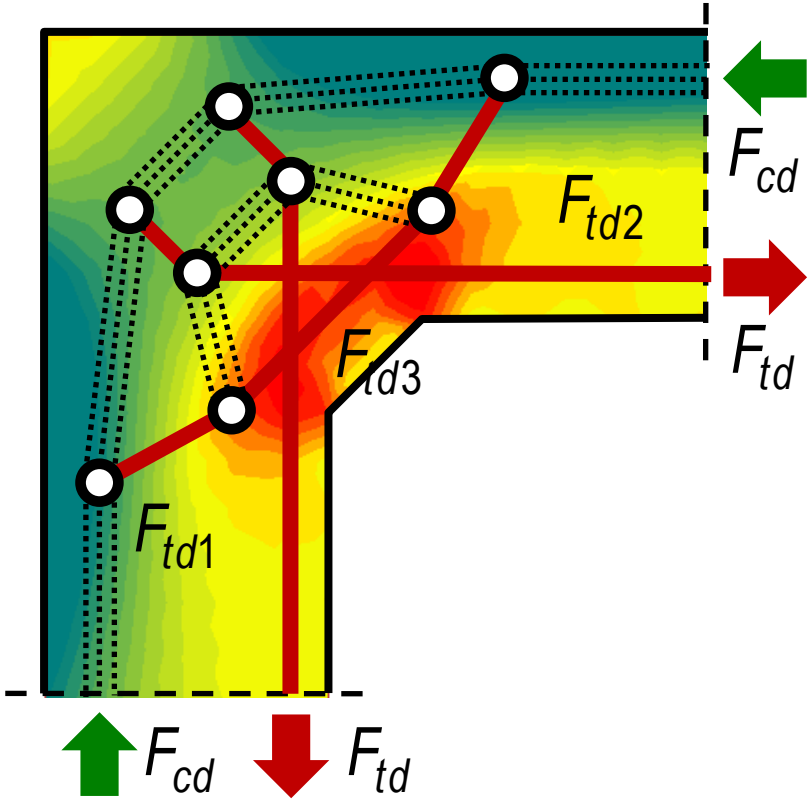


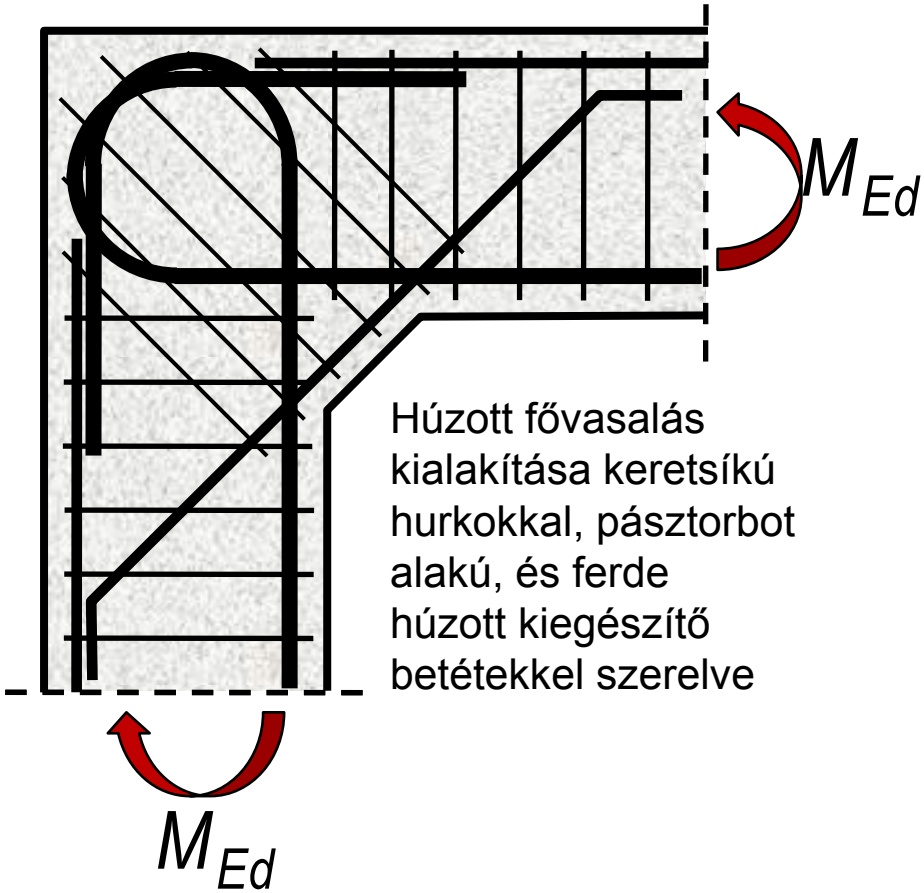
Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Strut-and-tie modell for an enlarged opening RC frame corner I.

Nyíló kiékelt vasbeton keretsarok rácsostartó modellje I.

Kiékelt keretsarok rácsostartó modellje és vasalása

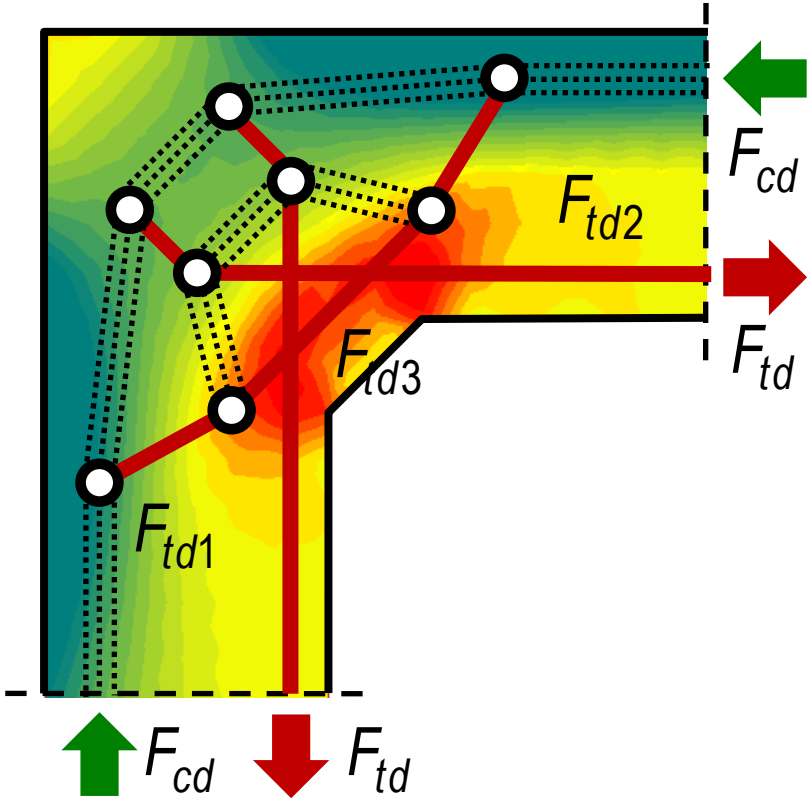


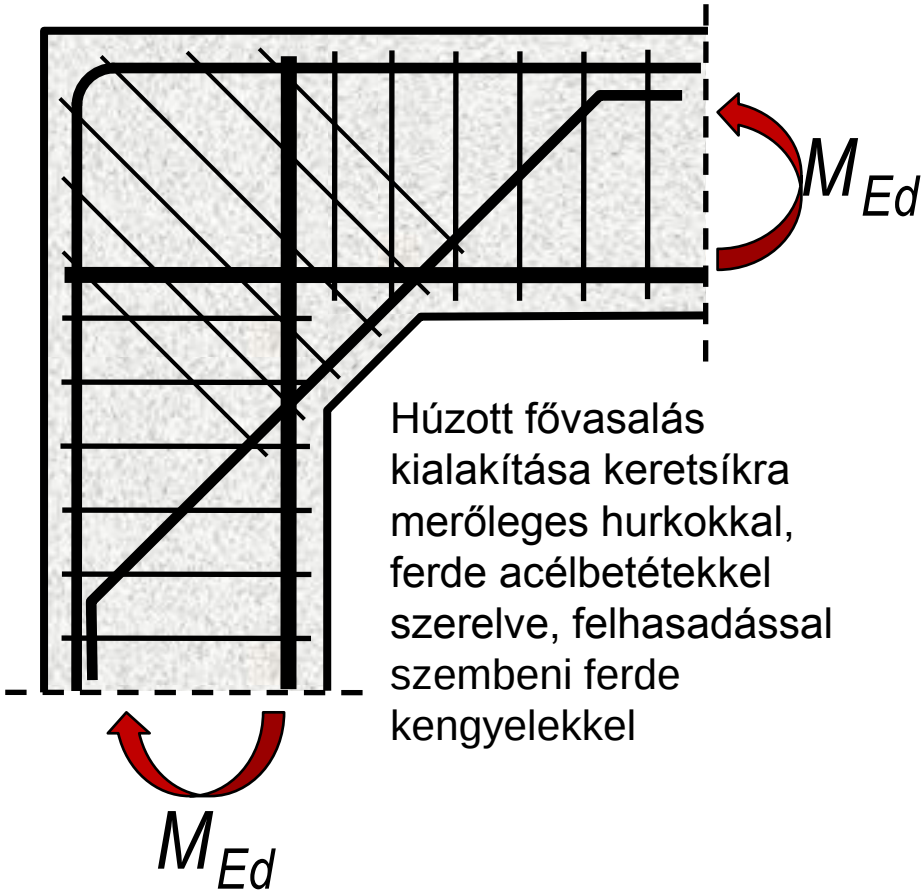


Strut-and-tie modell for an enlarged opening RC frame corner II.

Nyíló kiékelt vasbeton keretsarok rácsostartó modellje II.

Kiékelt keretsarok rácsostartó modellje és vasalása

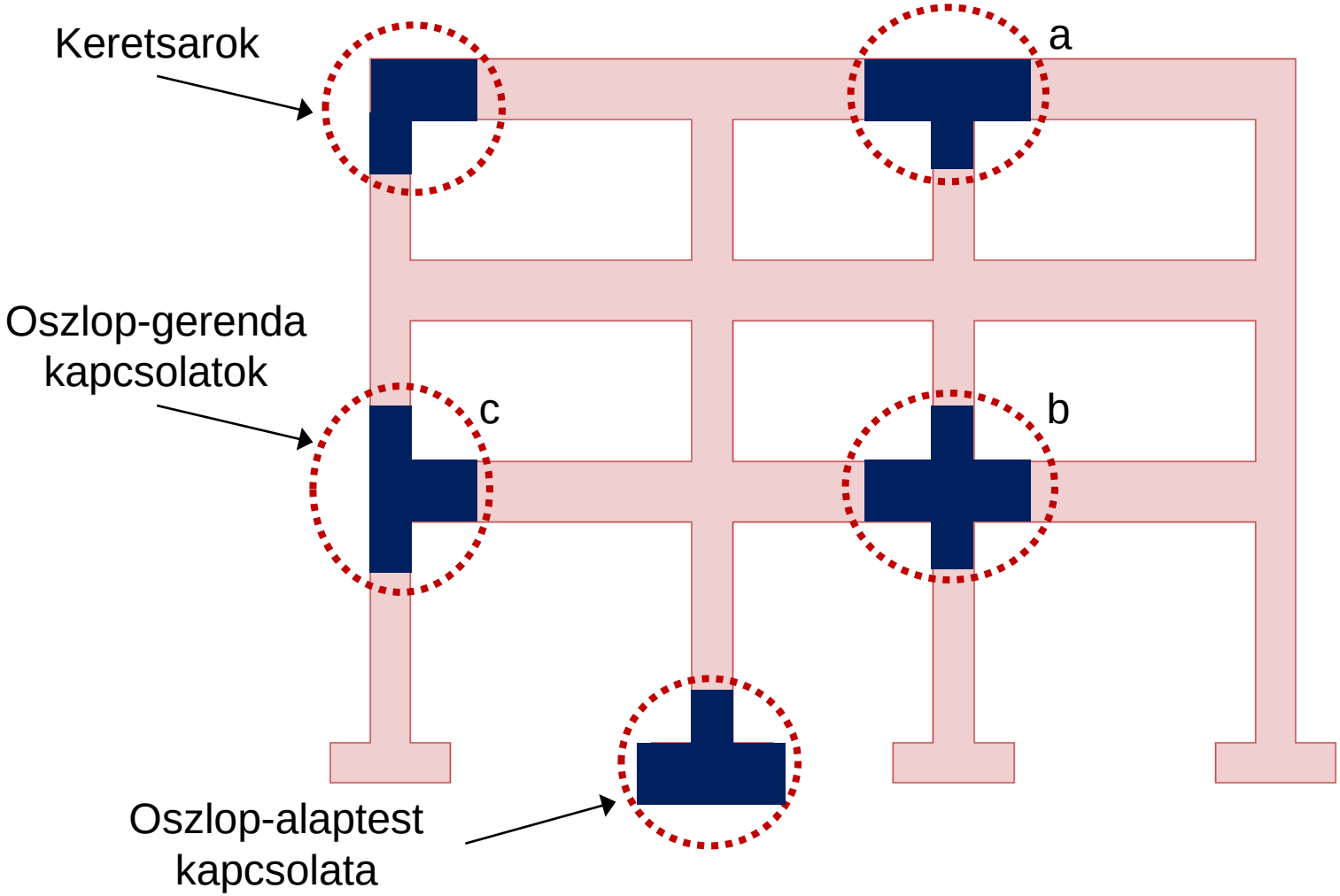




Húzott fővasalás kialakítása keretsíkra merőleges hurkokkal, ferde acélbetétekkel szerelve, felhasadással szembeni ferde kengyelekkel

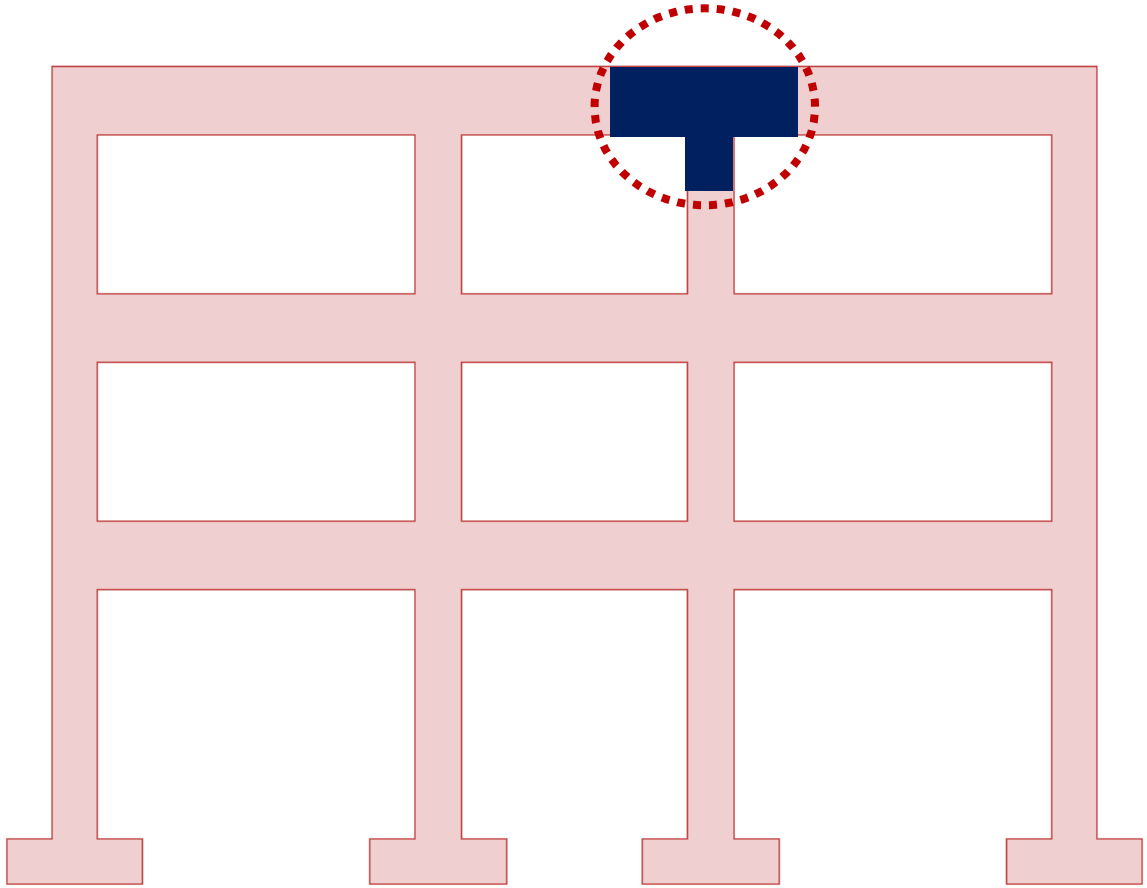
Rigid column-beam joints for multistory RC frame

Többszintes vasbeton keret merev oszlop-gerenda kapcsolatai



Rigid column-beam joint for multistory RC frame I.

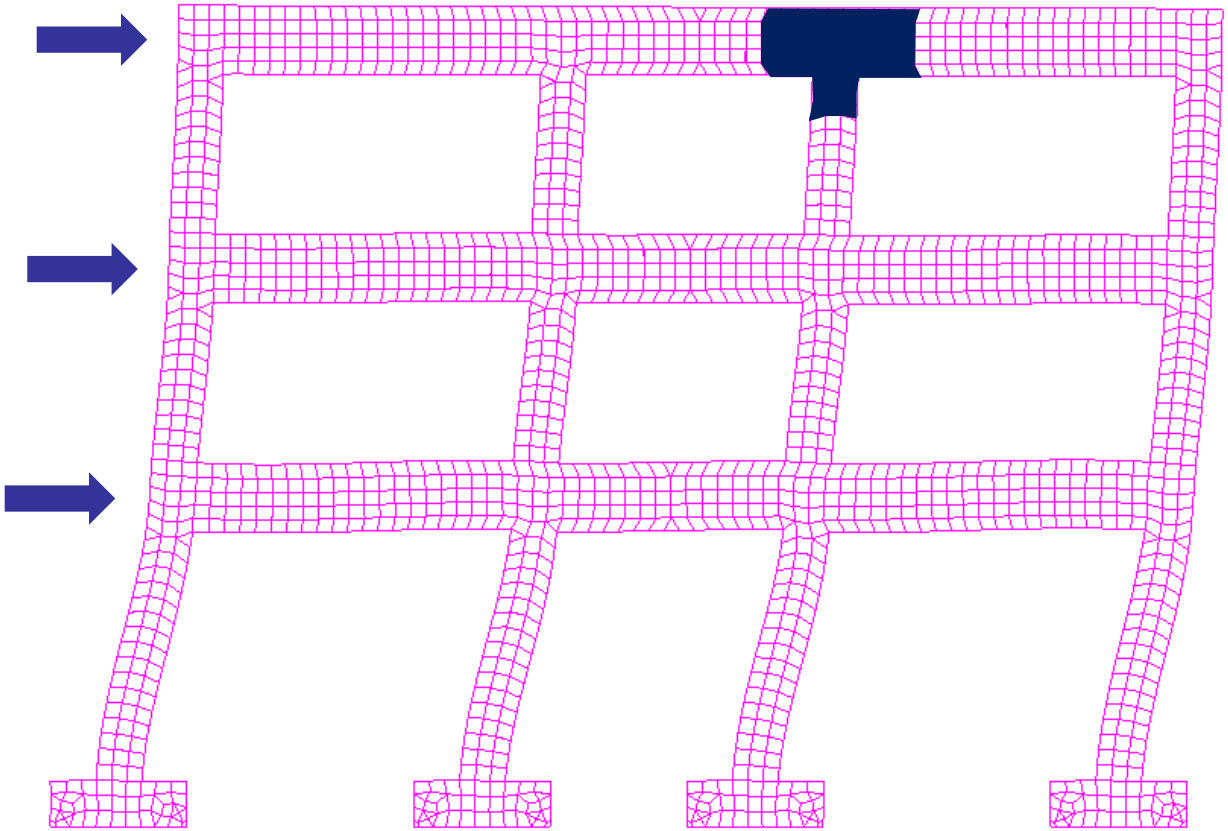
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.



Merevítetlen keret közbenső pillér-zárógerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame I.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.

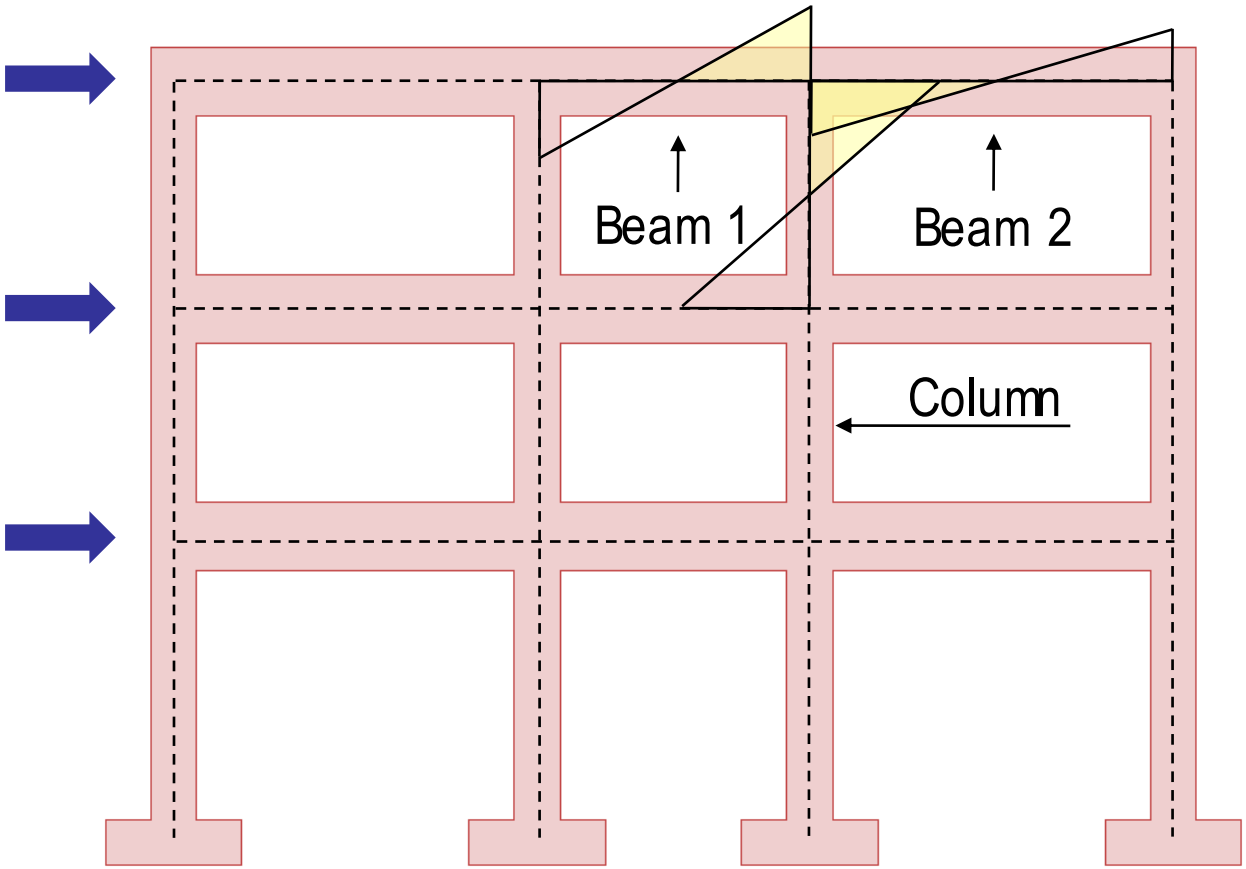


Szeizmikus tervezési helyzet – jelentős vízszintes terhek

Rigid column-beam joint for multistory RC frame I.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.

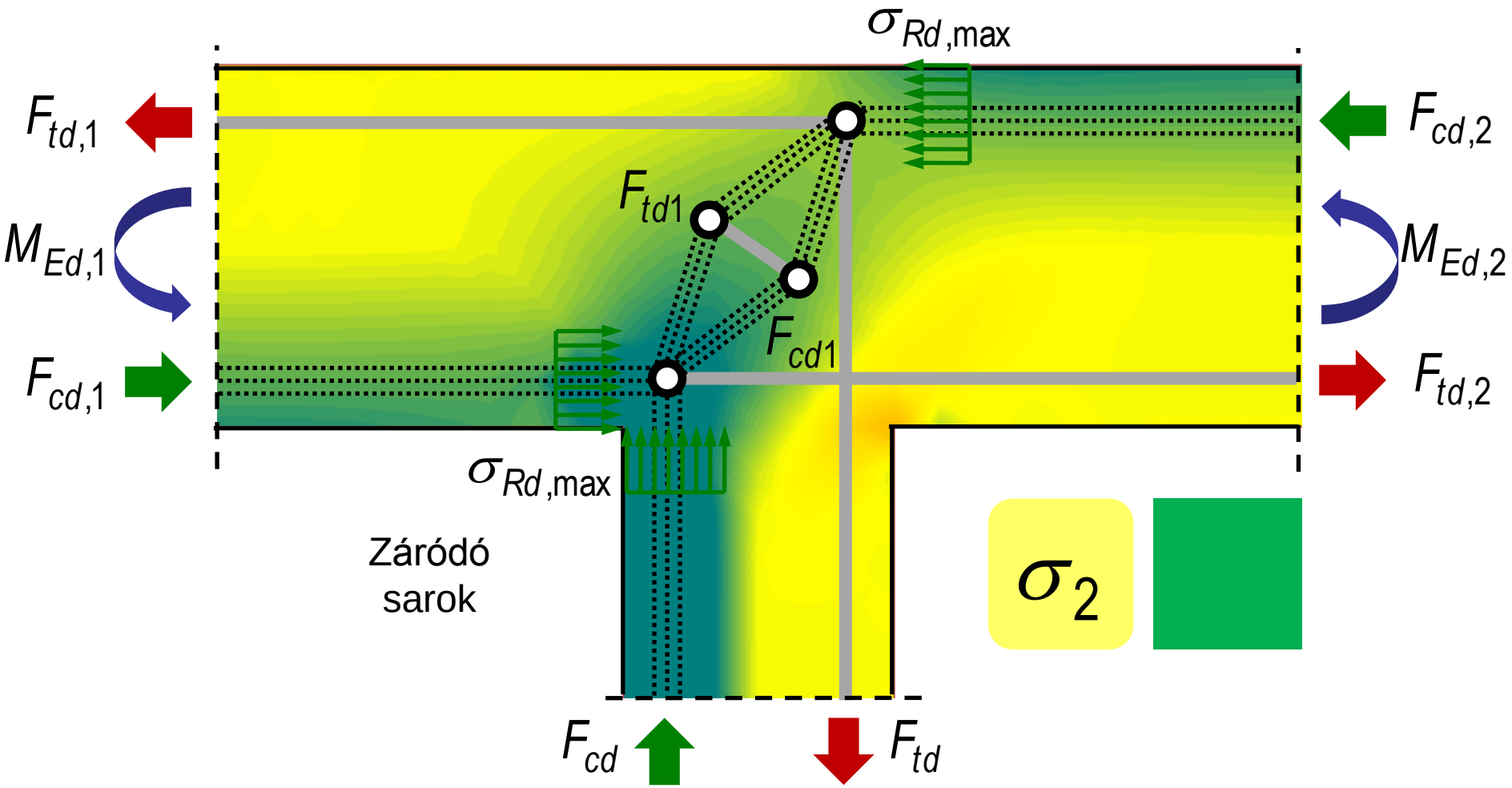
$$M_{Ed,column} = M_{Ed,beam,1} + M_{Ed,beam,2}$$



Szeizmikus tervezési helyzet – jelentős vízszintes terhek

Rigid column-beam joint for multistory RC frame I.

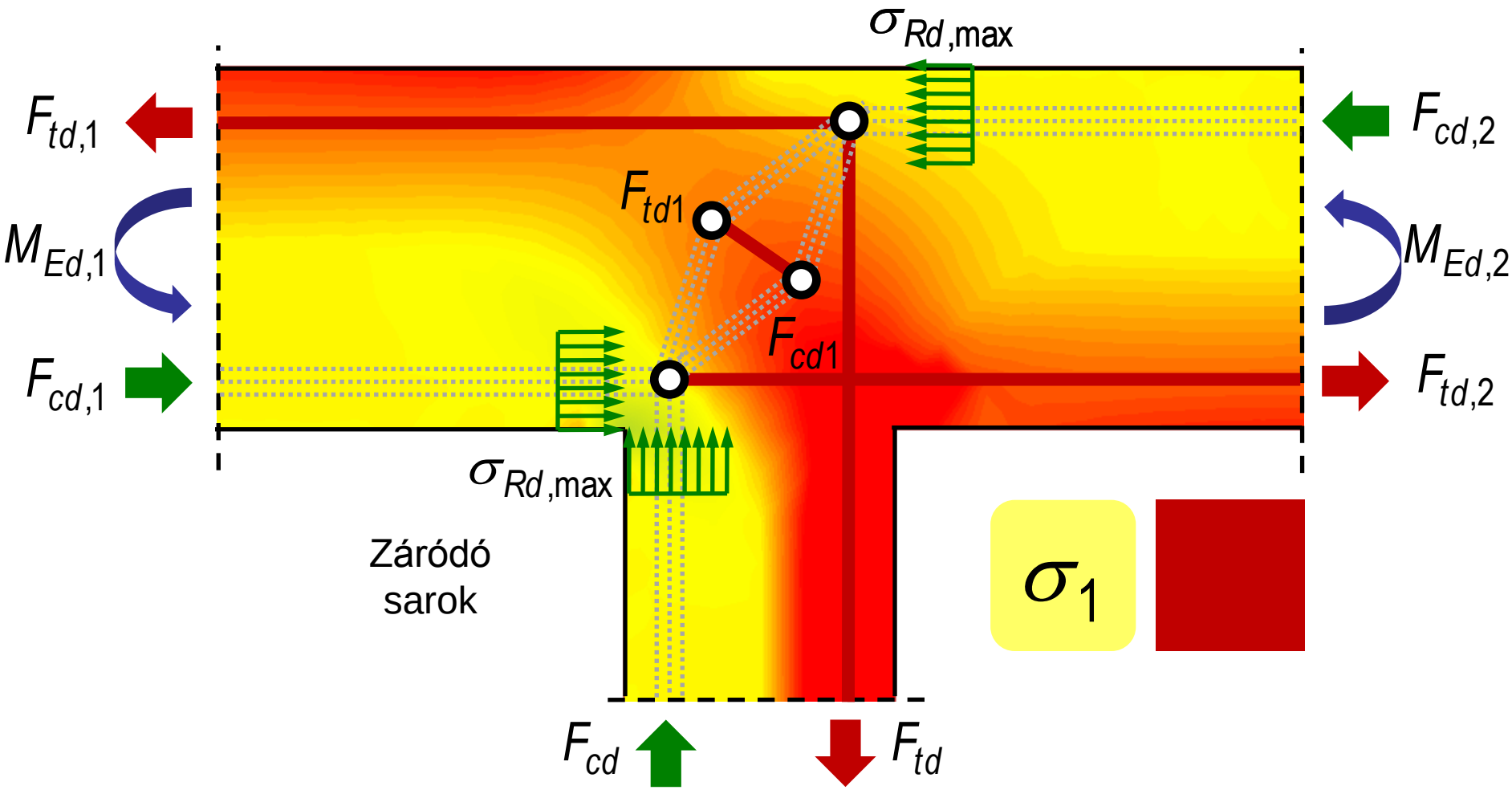
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.



Nyomott beton rácsrudak kialakulása a legjobban nyomott zónákban - beton

Rigid column-beam joint for multistory RC frame I.

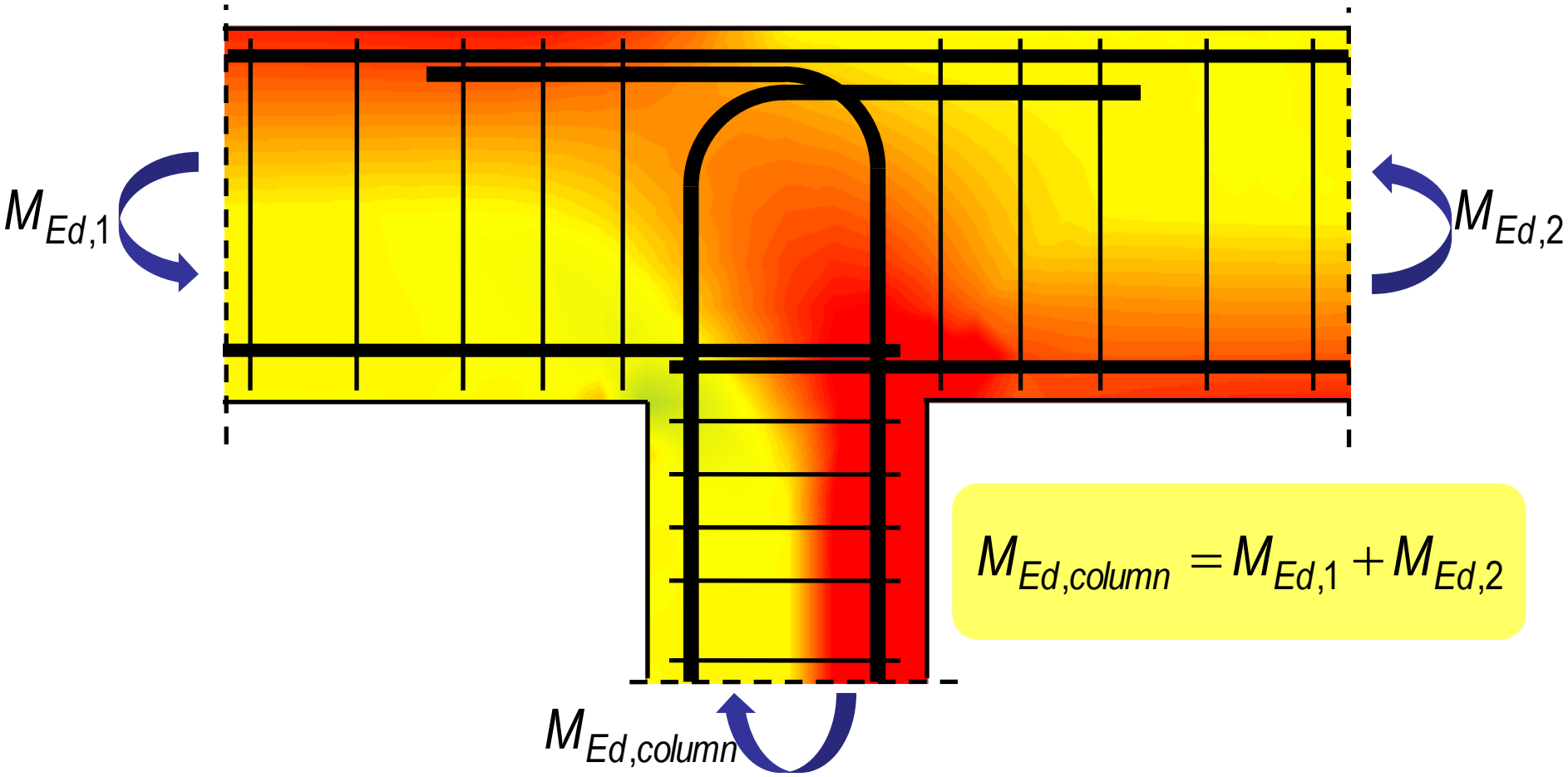
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.



Húzott rácsrudak, húzások felvétele a legjobban húzott zónákban acélbetétekkel

Rigid column-beam joint for multistory RC frame I.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata I.

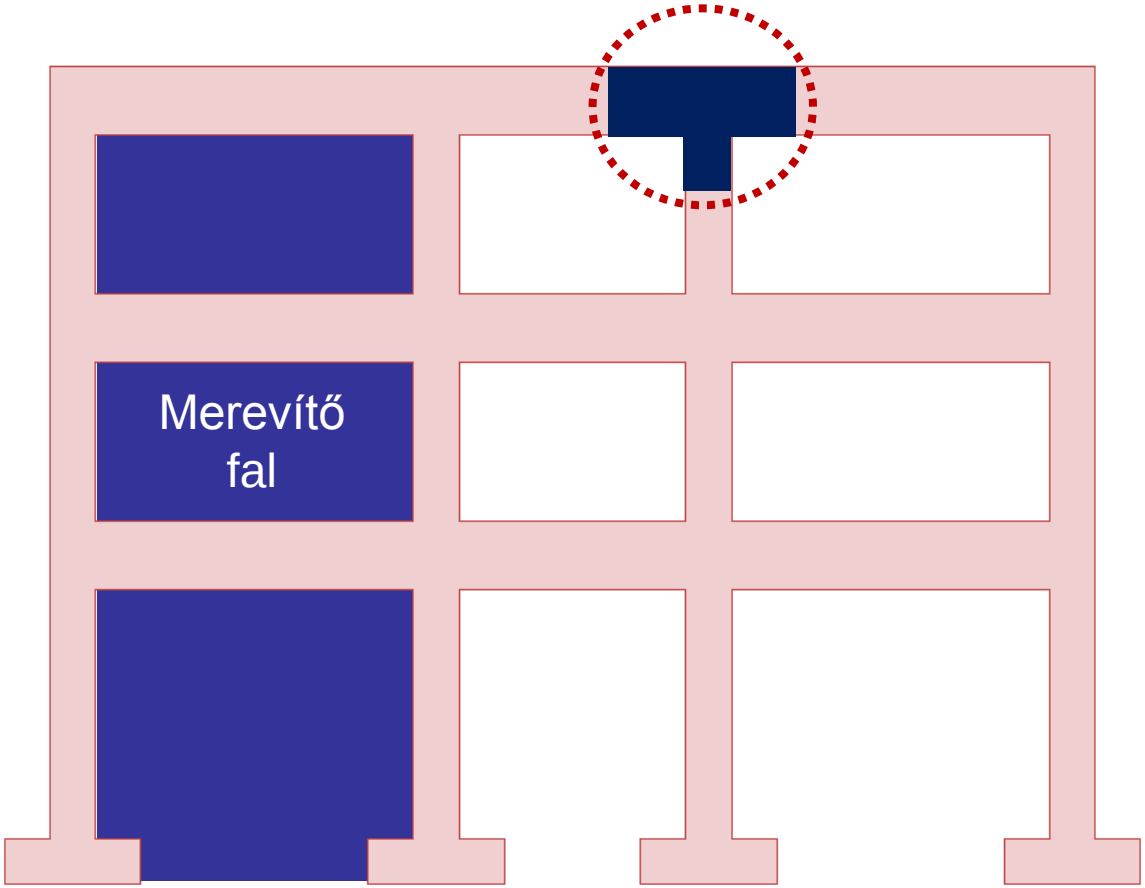


$$M_{Ed,column} = M_{Ed,1} + M_{Ed,2}$$

A kétirányú terhelés lehetősége miatt javasolt szimmetrikus vasvezetés

Rigid column-beam joint for multistory RC frame II.

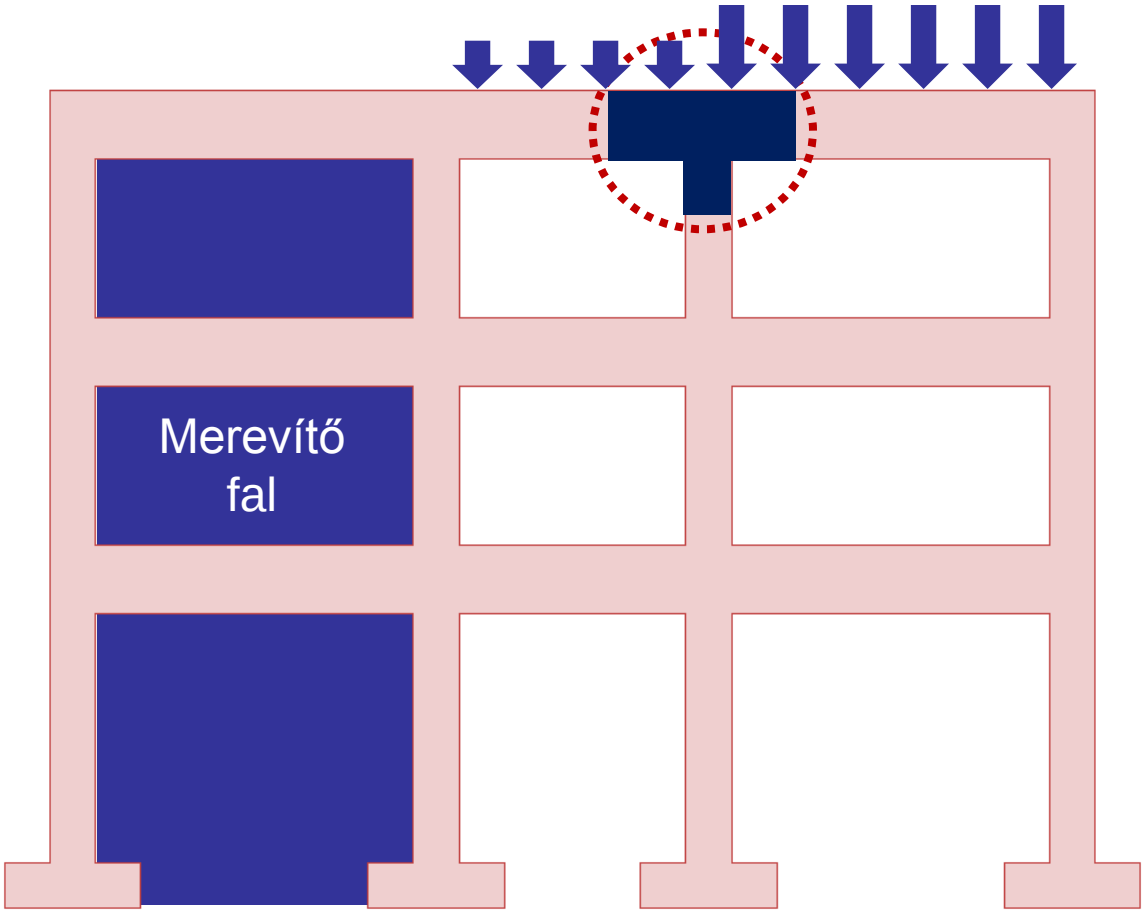
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



Merevített keret közbenső pillér-zárógerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame II.

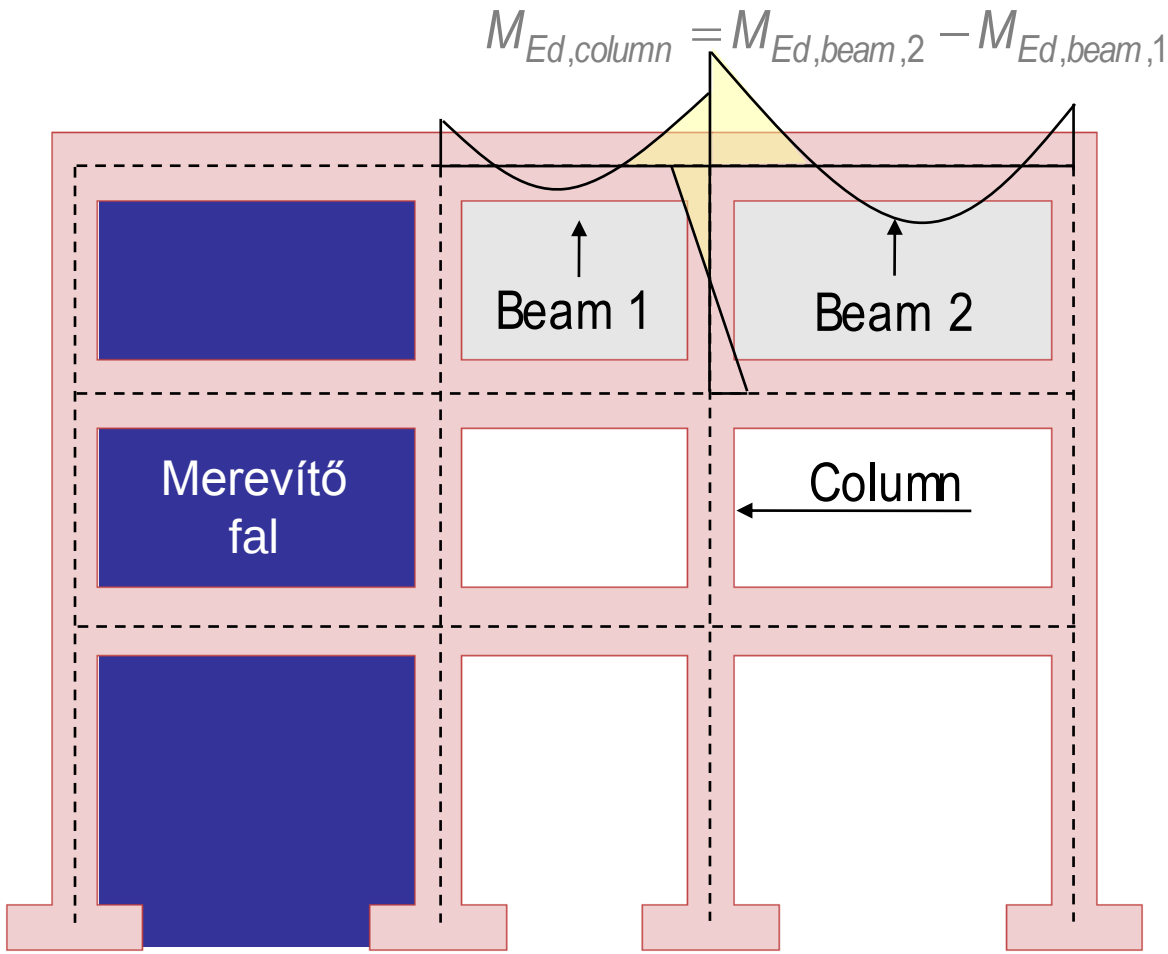
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



A vízszintes hatásokat a merevítő falak veszik fel, a függőleges terhek dominánsak

Rigid column-beam joint for multistory RC frame II.

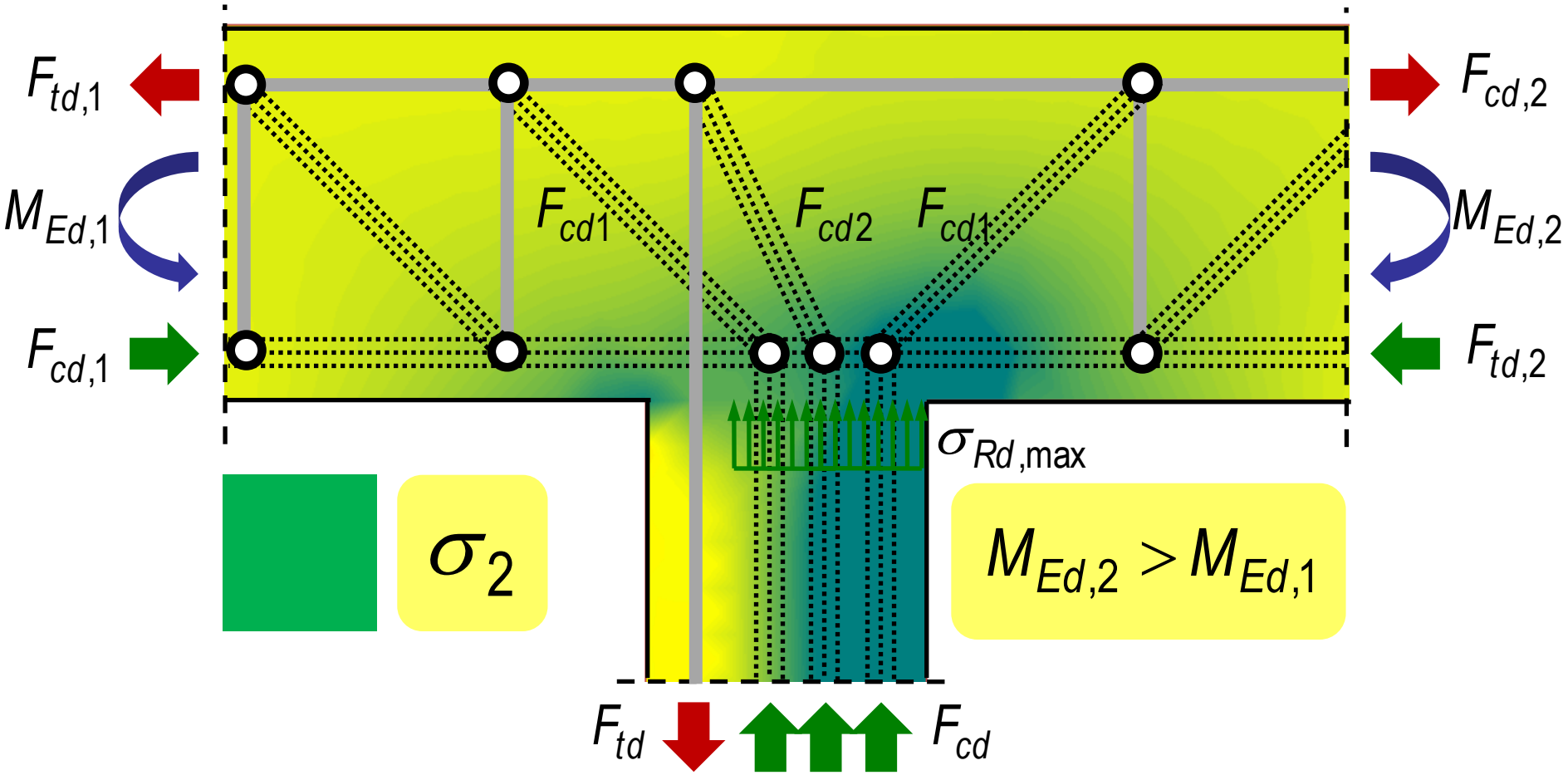
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



A vízszintes hatásokat a merevítő falak veszik fel, a függőleges terhek dominánsak

Rigid column-beam joint for multistory RC frame II.

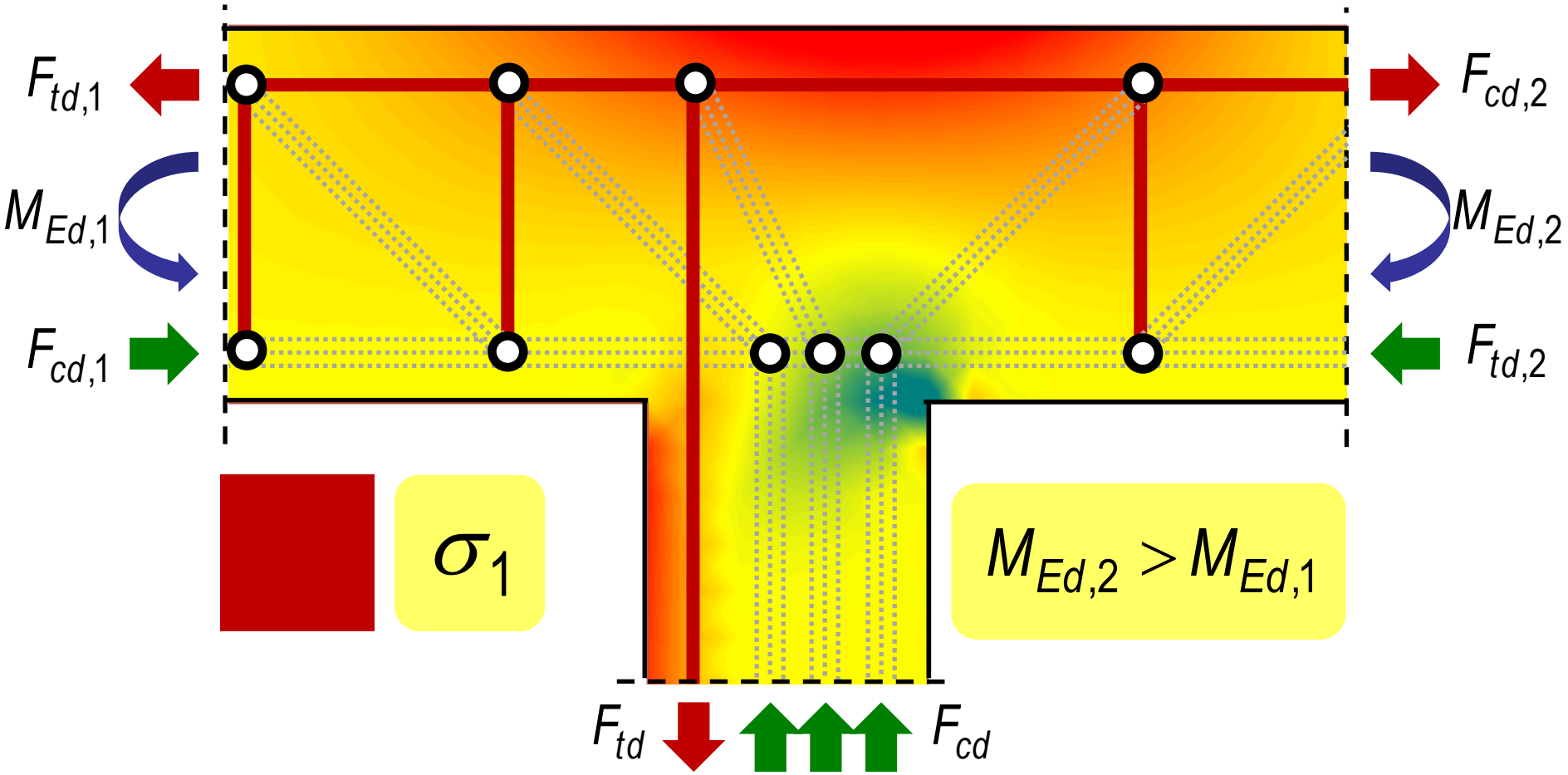
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



Nyomott beton rácsrudak kialakulása a legjobban nyomott zónákban - beton

Rigid column-beam joint for multistory RC frame II.

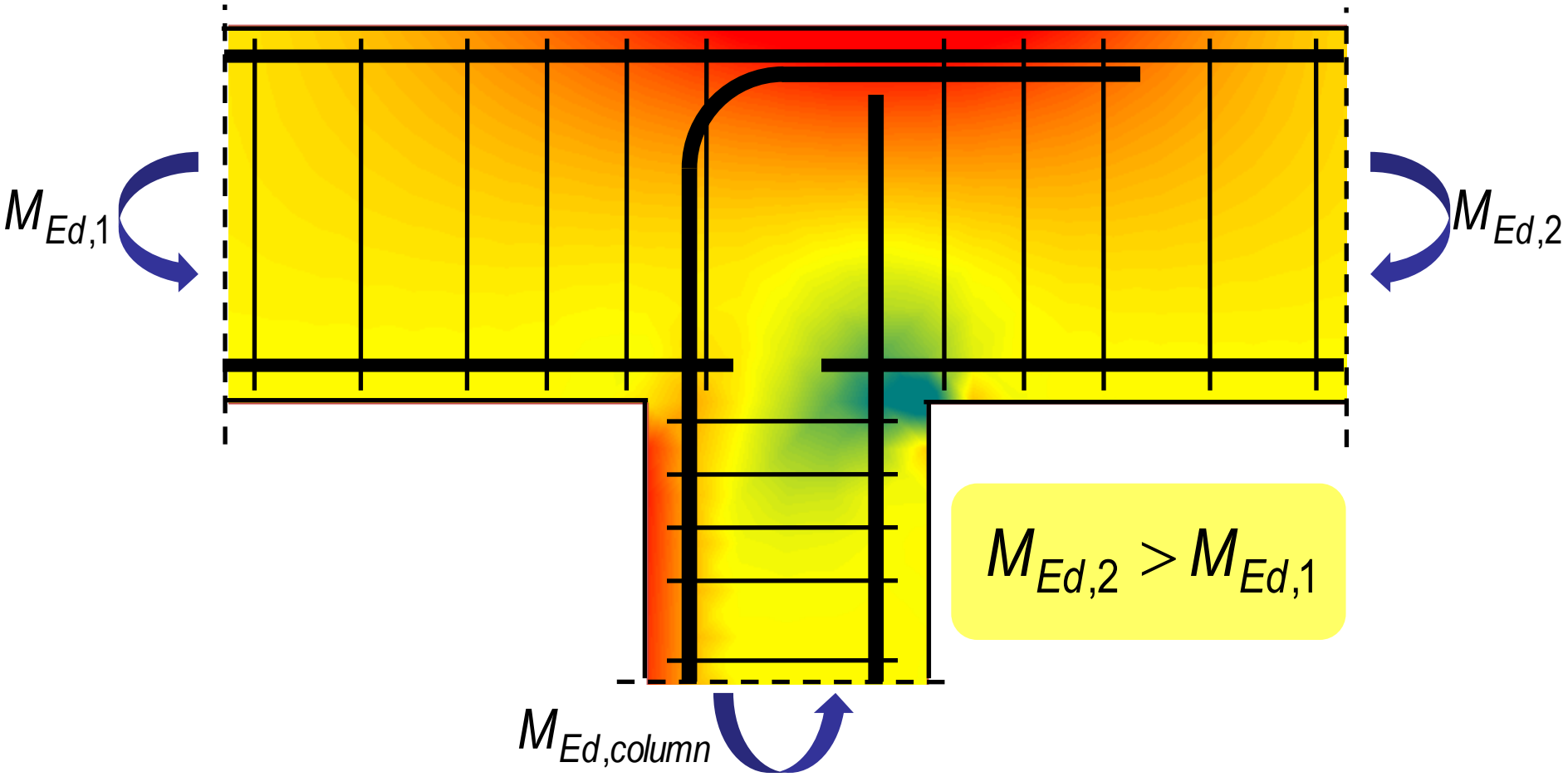
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



Húzott rácsrudak, húzások felvétele a legjobban húzott zónákban acélbetétekkel

Rigid column-beam joint for multistory RC frame II.

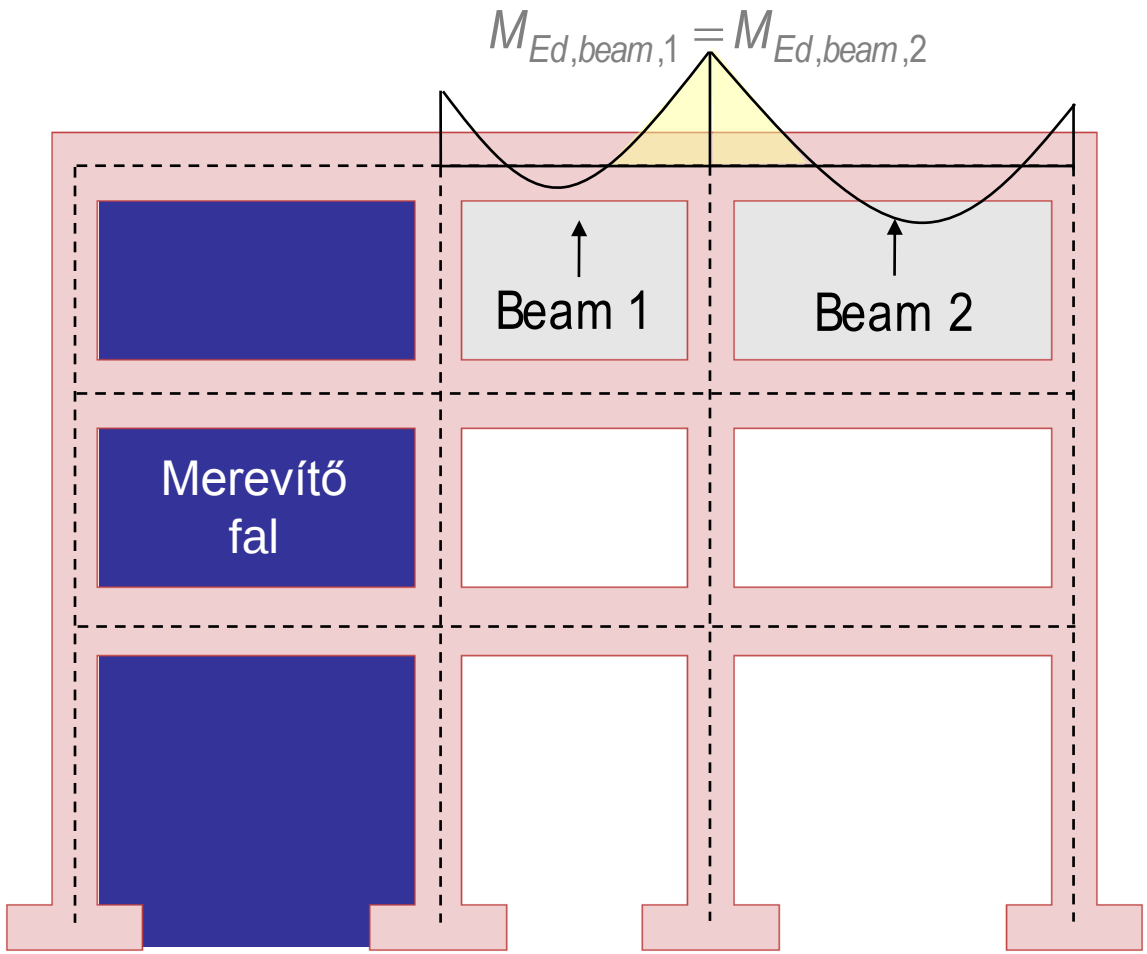
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata II.



A jellemzően aszimmetrikus igénybevétel eloszlás miatt javasolt vasvezetés

Rigid column-beam joint for multistory RC frame III.

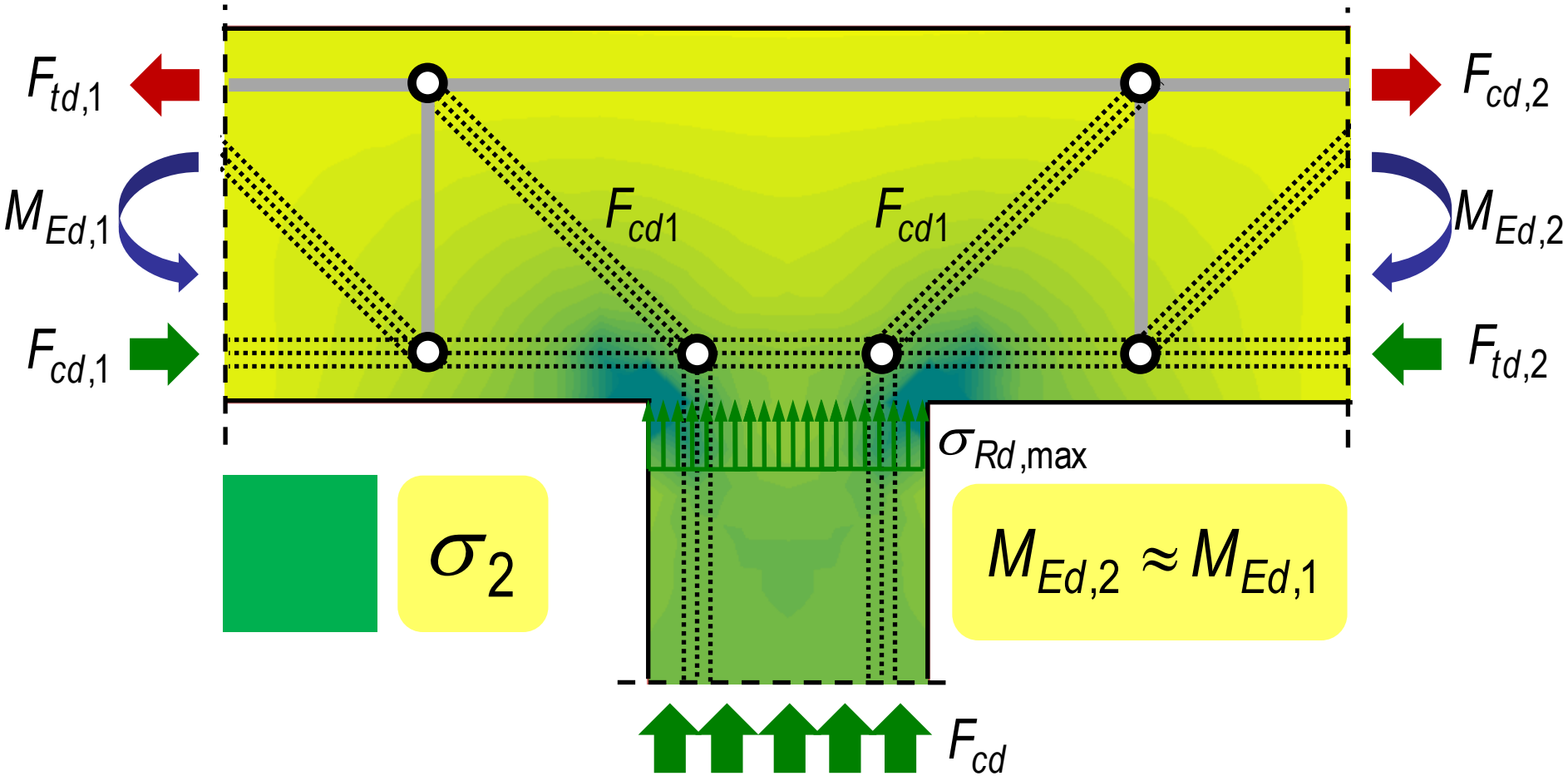
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata III.



Azonos negatív gerendanyomatékok az oszlop feletti keresztmetszetben

Rigid column-beam joint for multistory RC frame III.

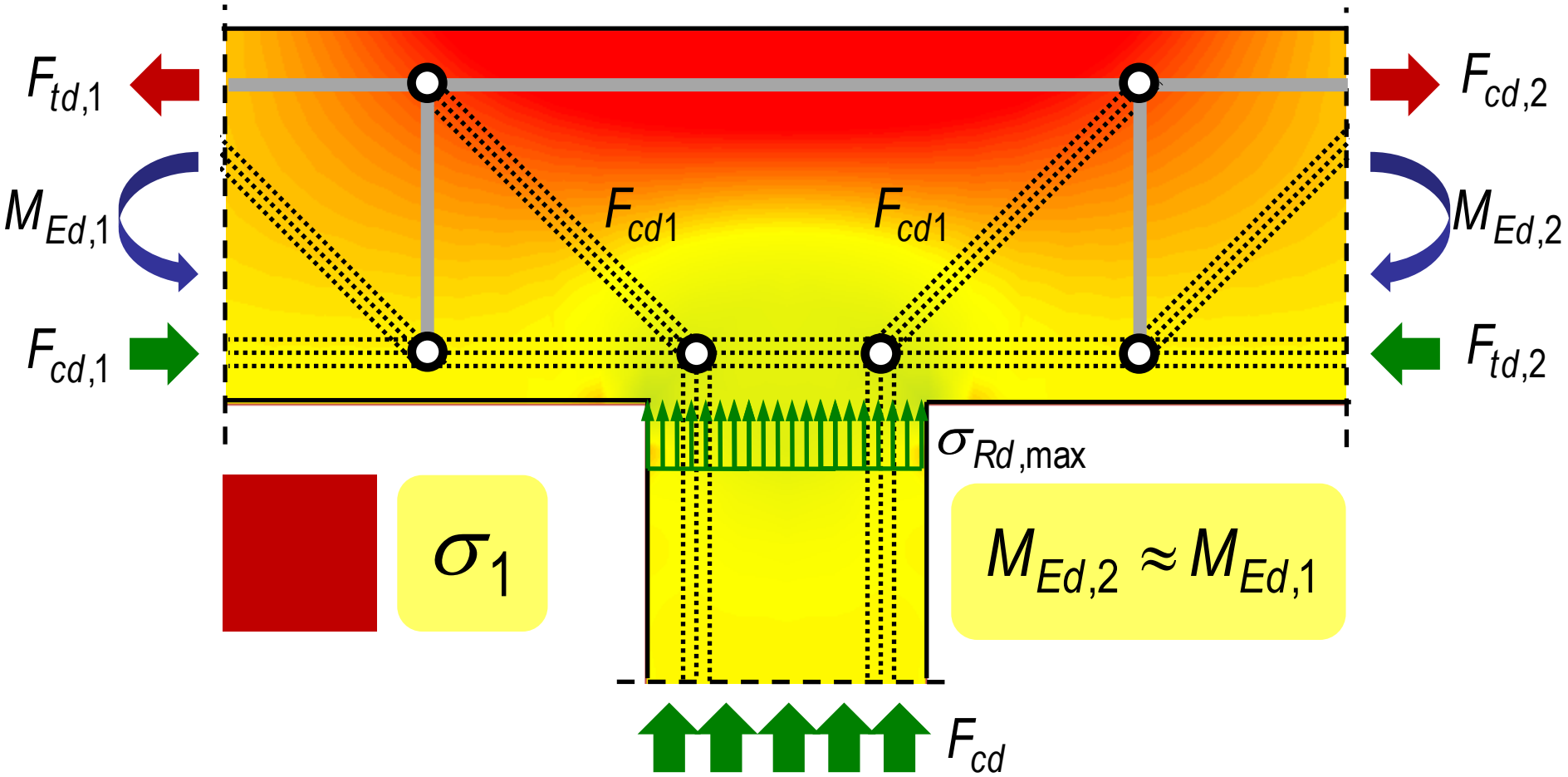
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata III.



Nyomott beton rácsrudak kialakulása a legjobban nyomott zónákban - beton

Rigid column-beam joint for multistory RC frame III.

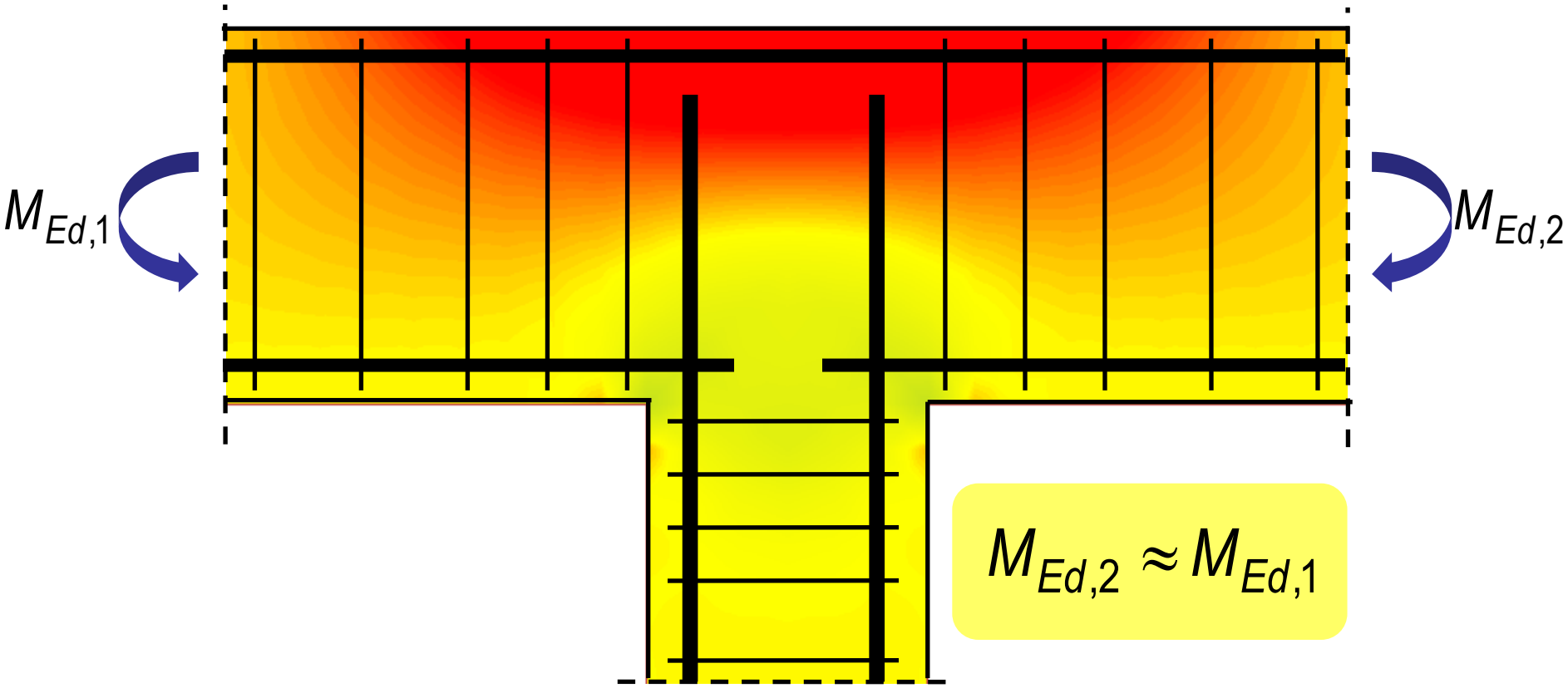
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata III.



Húzott rácsrudak, húzások felvétele a legjobban húzott zónákban acélbetétekkel

Rigid column-beam joint for multistory RC frame III.

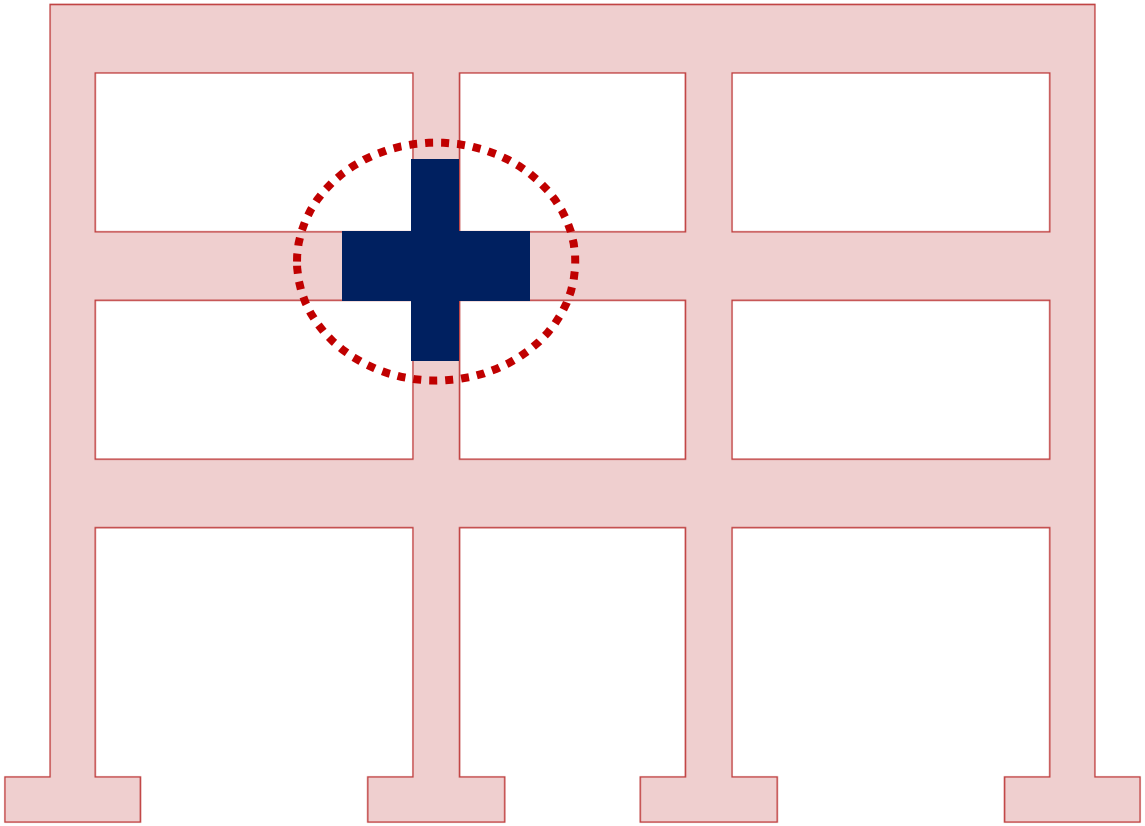
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata III.



A jellemzően szimmetrikus gerendaigénybevételek miatt javasolt vasvezetés

Rigid column-beam joint for multistory RC frame IV.

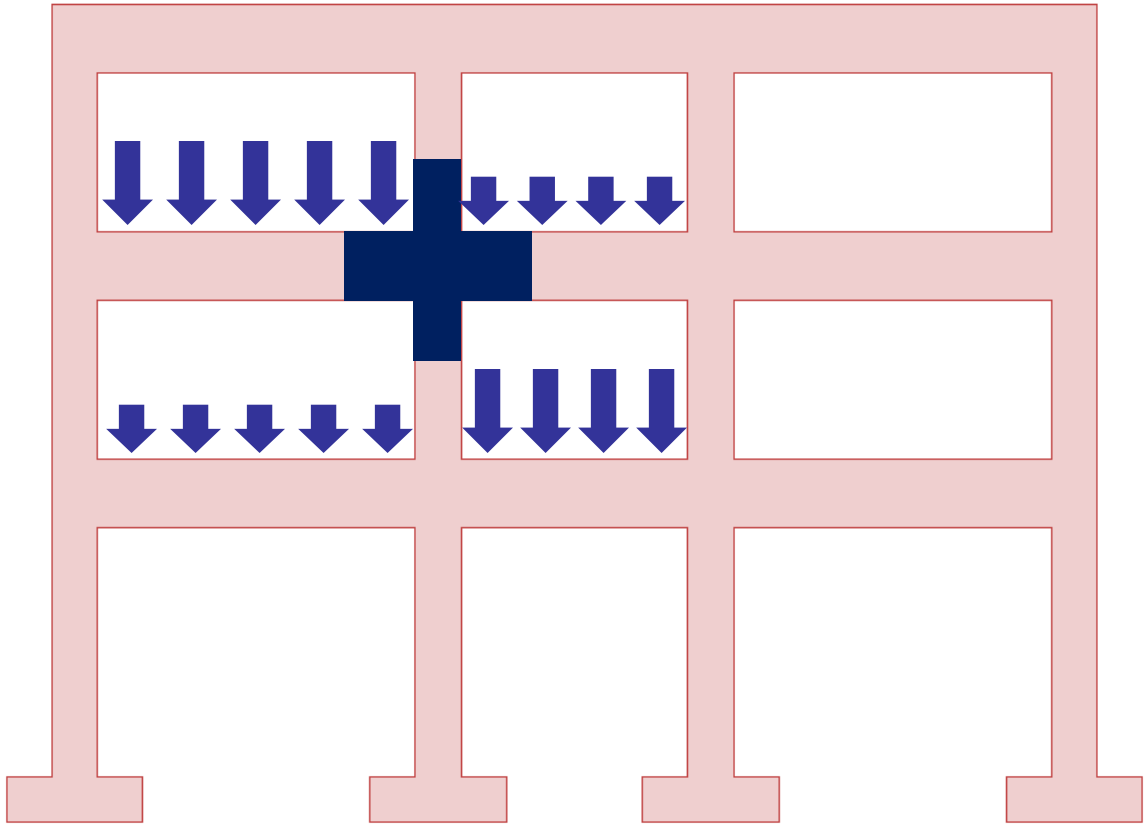
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.

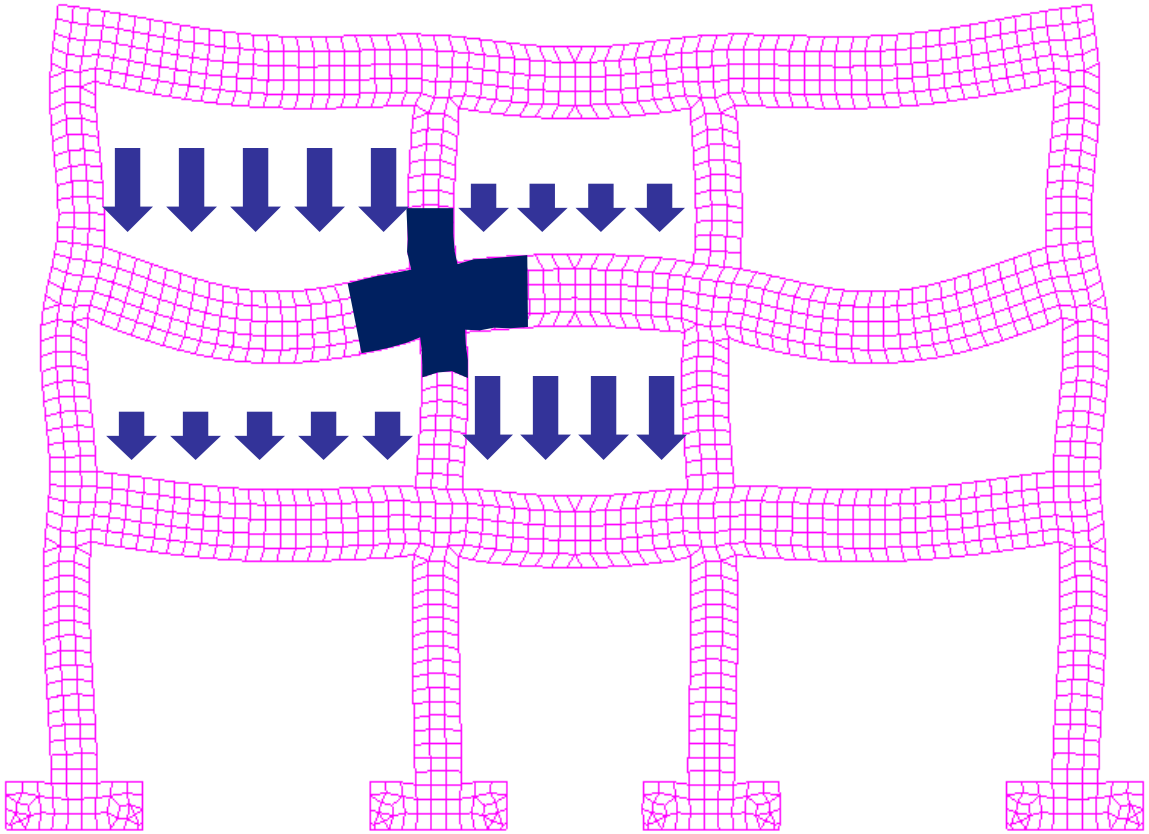


Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.

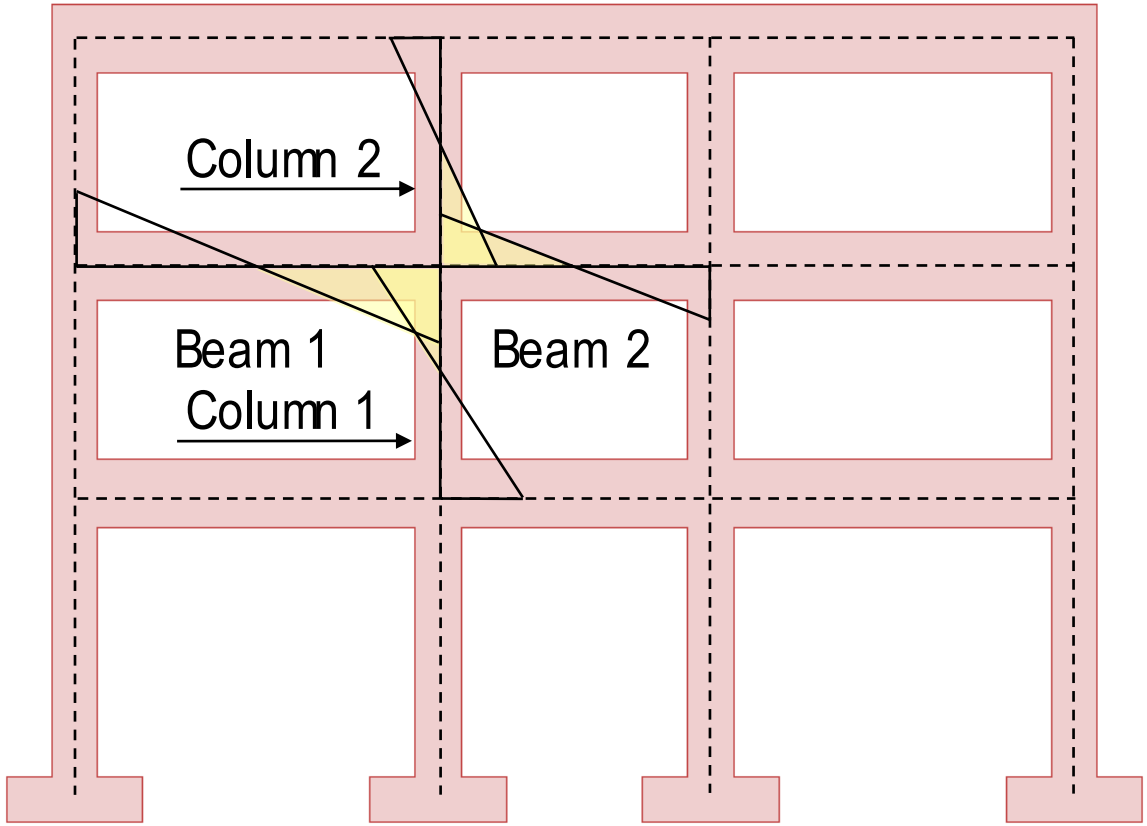


Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Rigid column-beam joint for multistory RC frame IV.

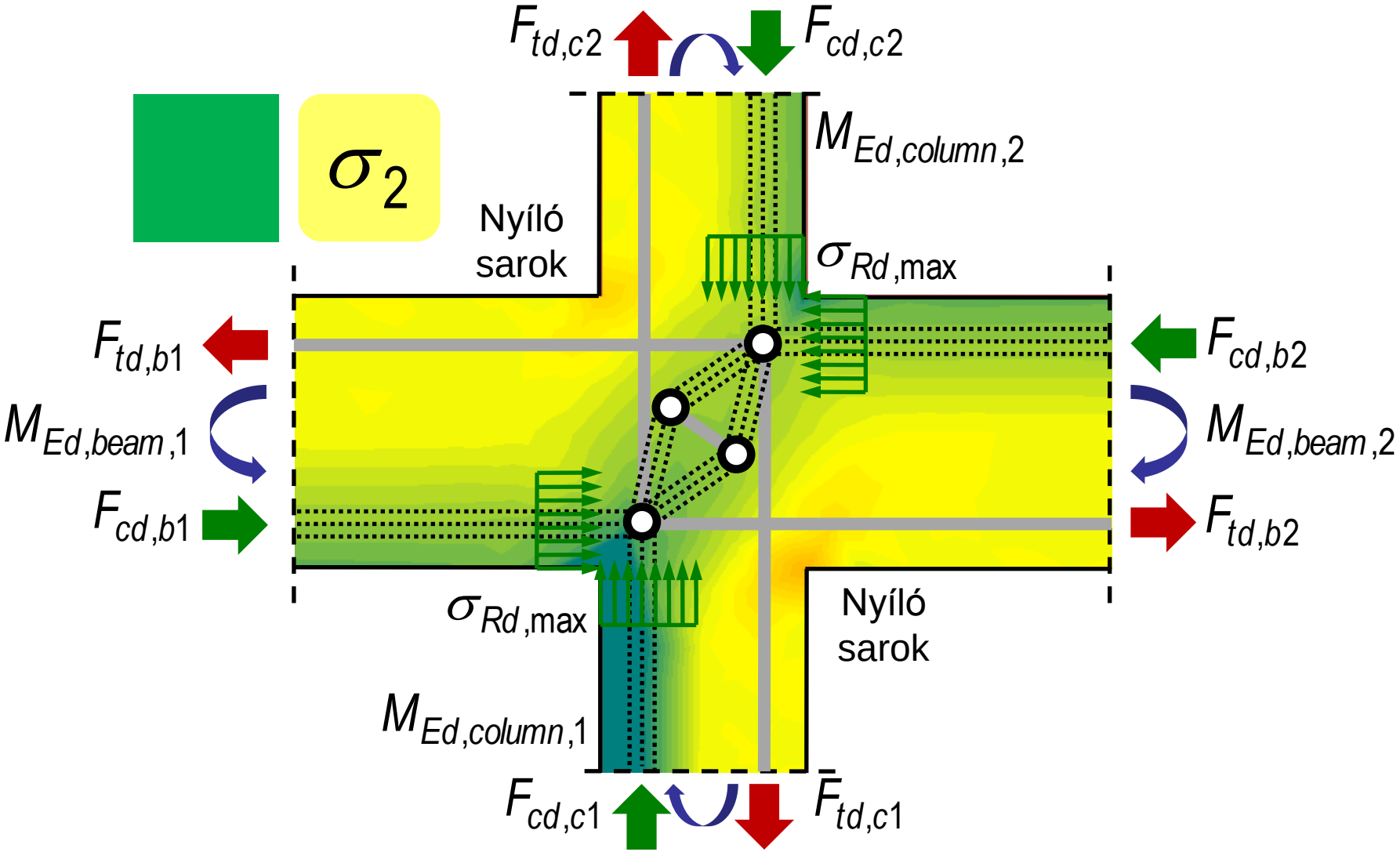
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

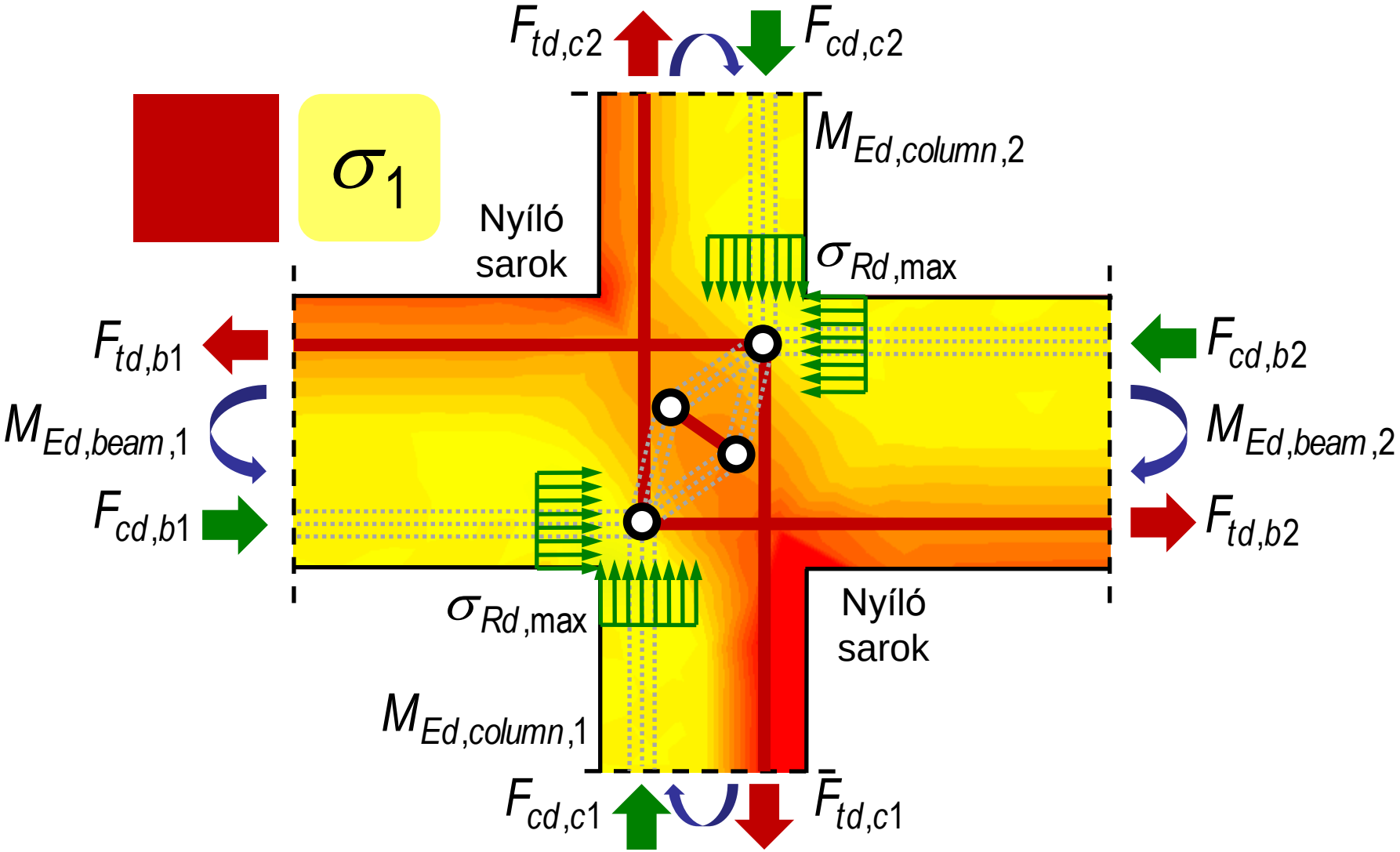
Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



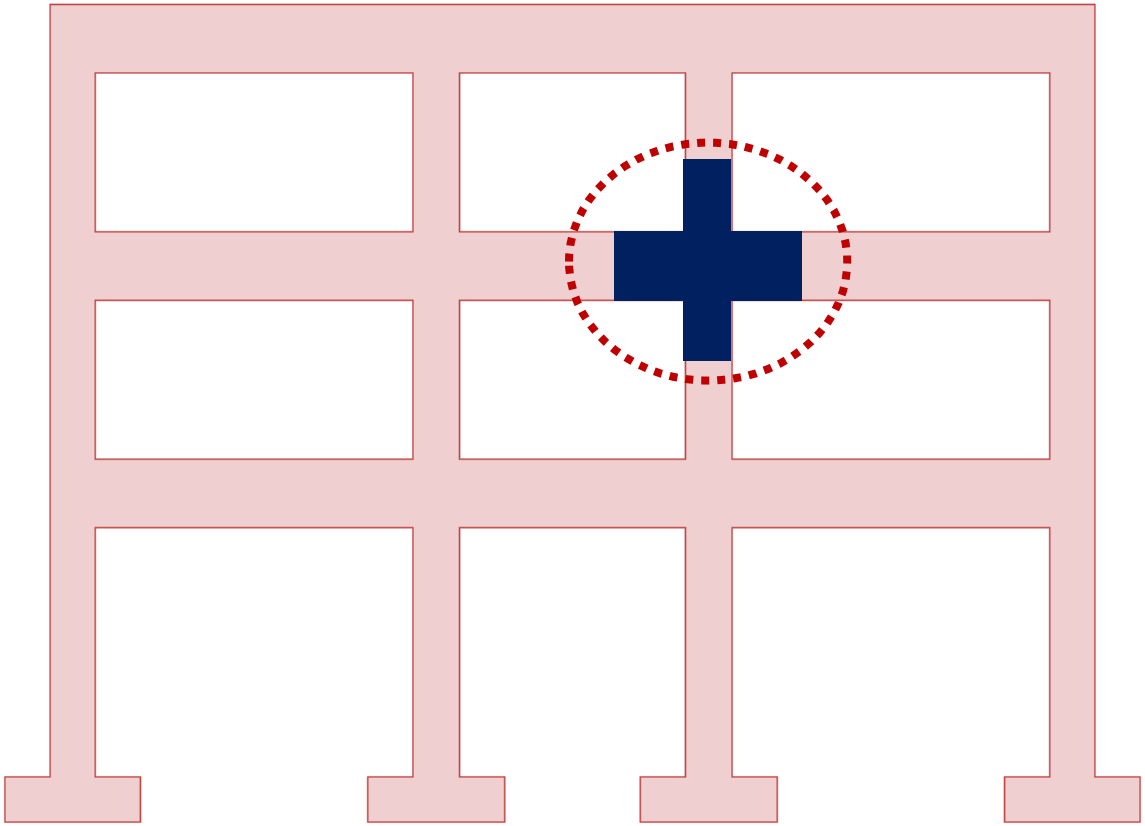
Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.

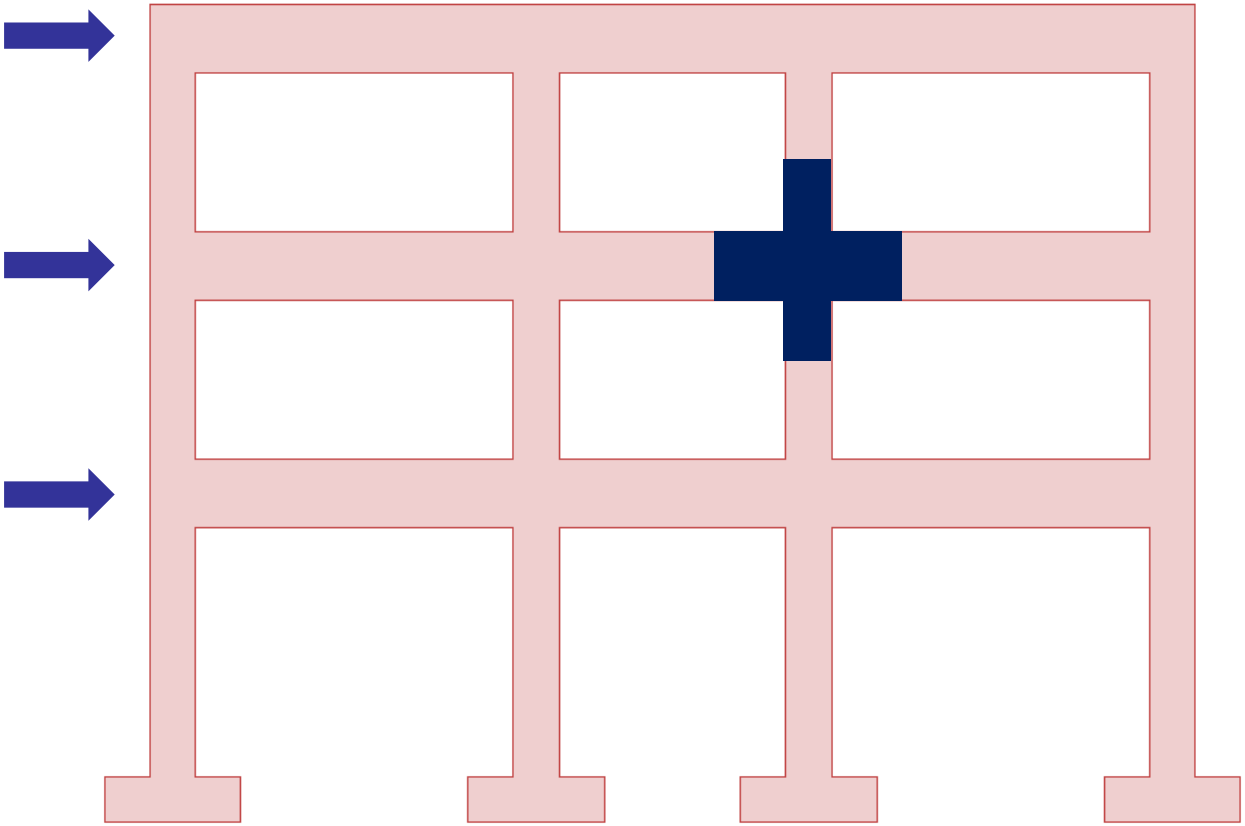


Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Rigid column-beam joint for multistory RC frame IV.

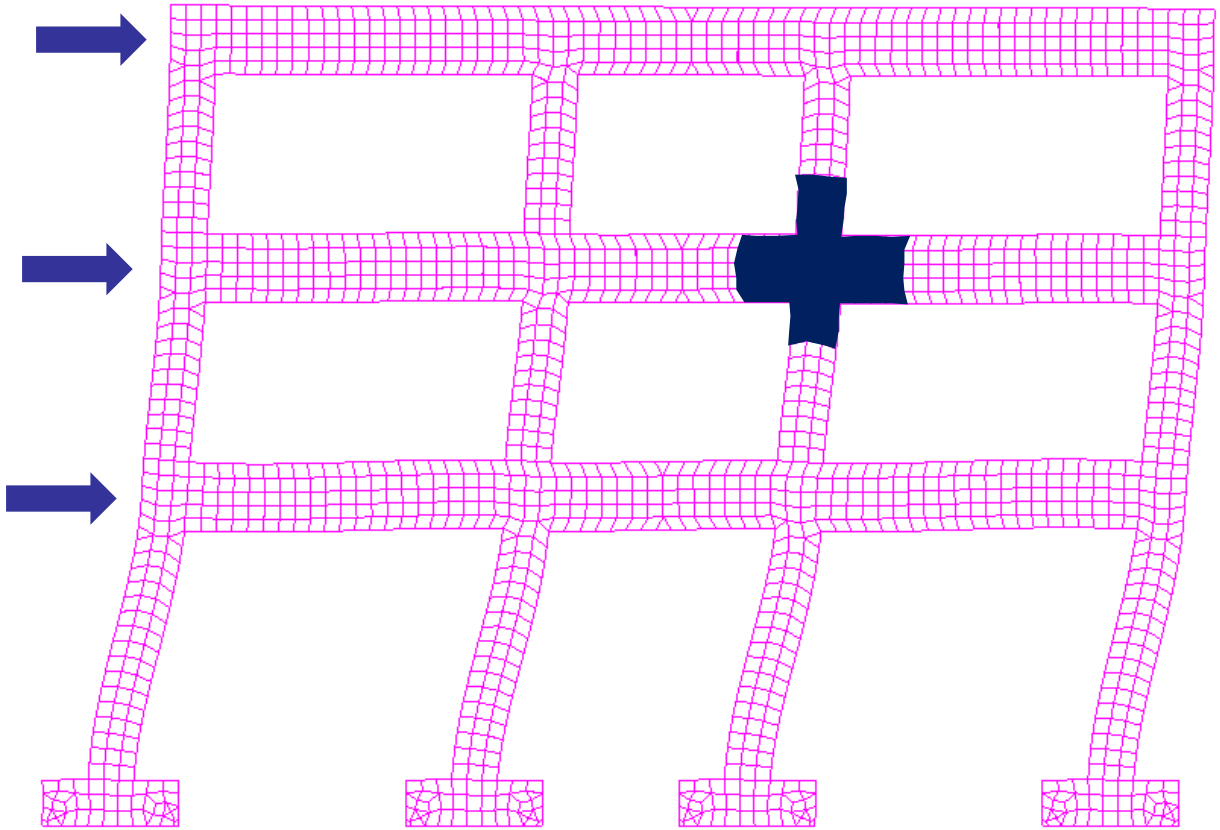
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.

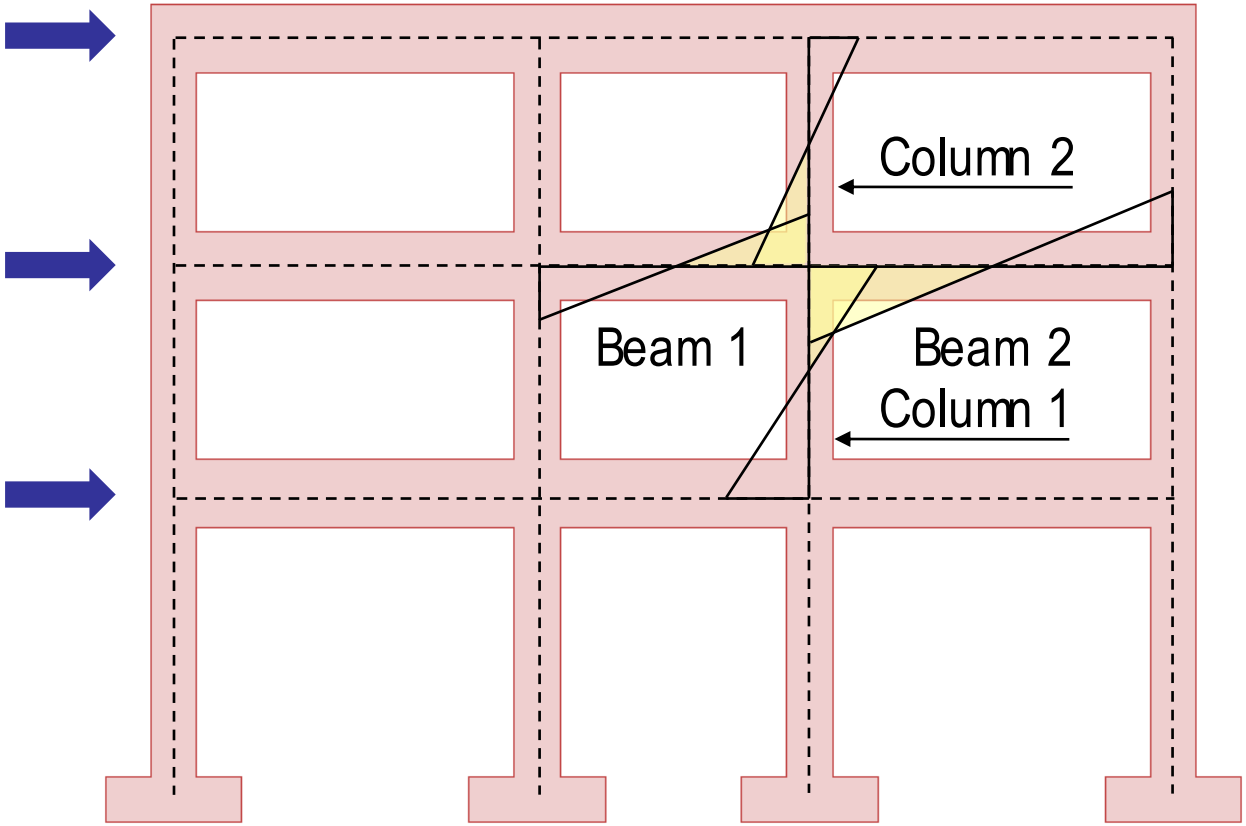


Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Dr. Kovács Imre PhD © Minden jog fenntartva!!!

Rigid column-beam joint for multistory RC frame IV.

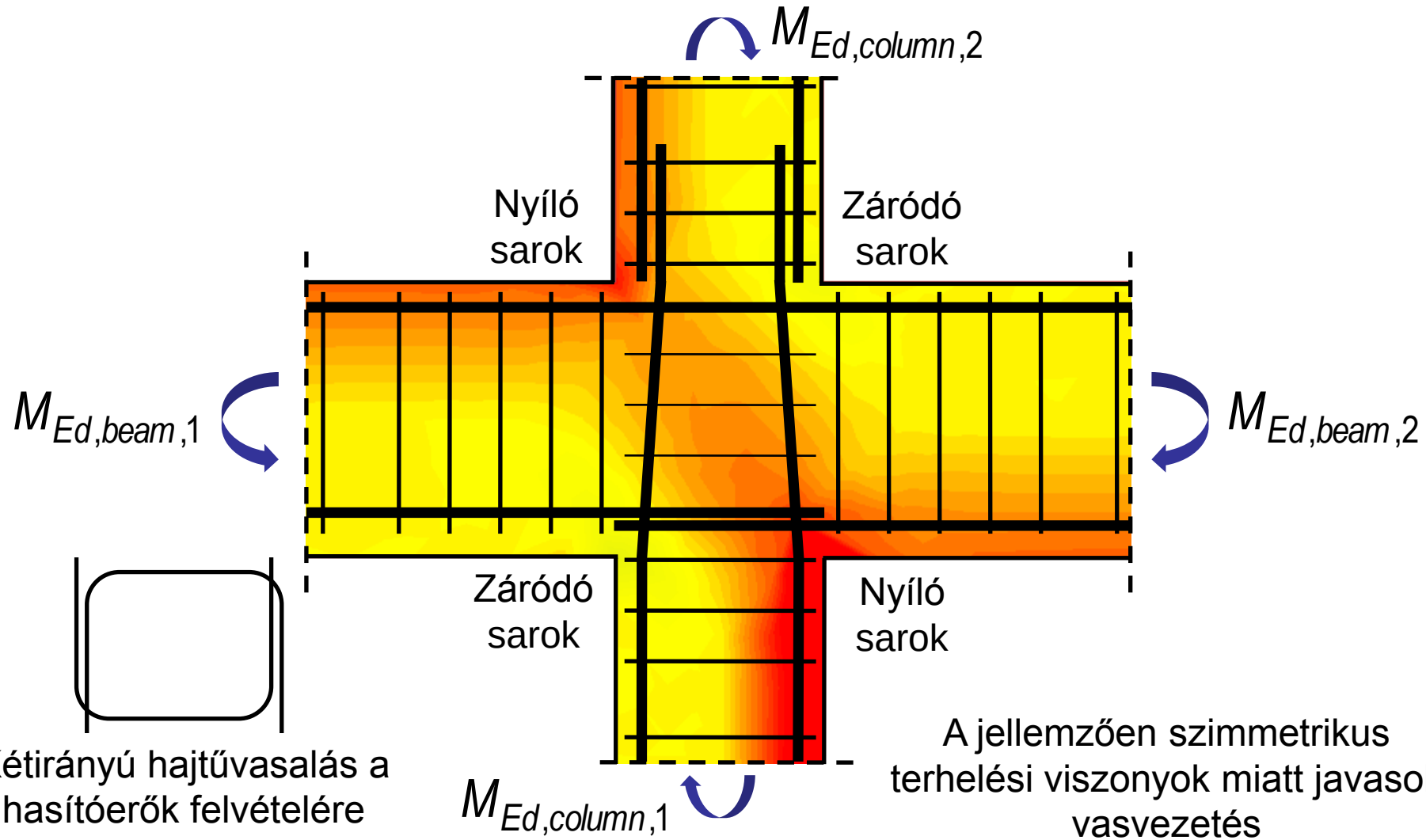
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame IV.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Kétirányú hajtűvasalás a hasítóerők felvételére

A jellemzően szimmetrikus terhelési viszonyok miatt javasolt vasvezetés

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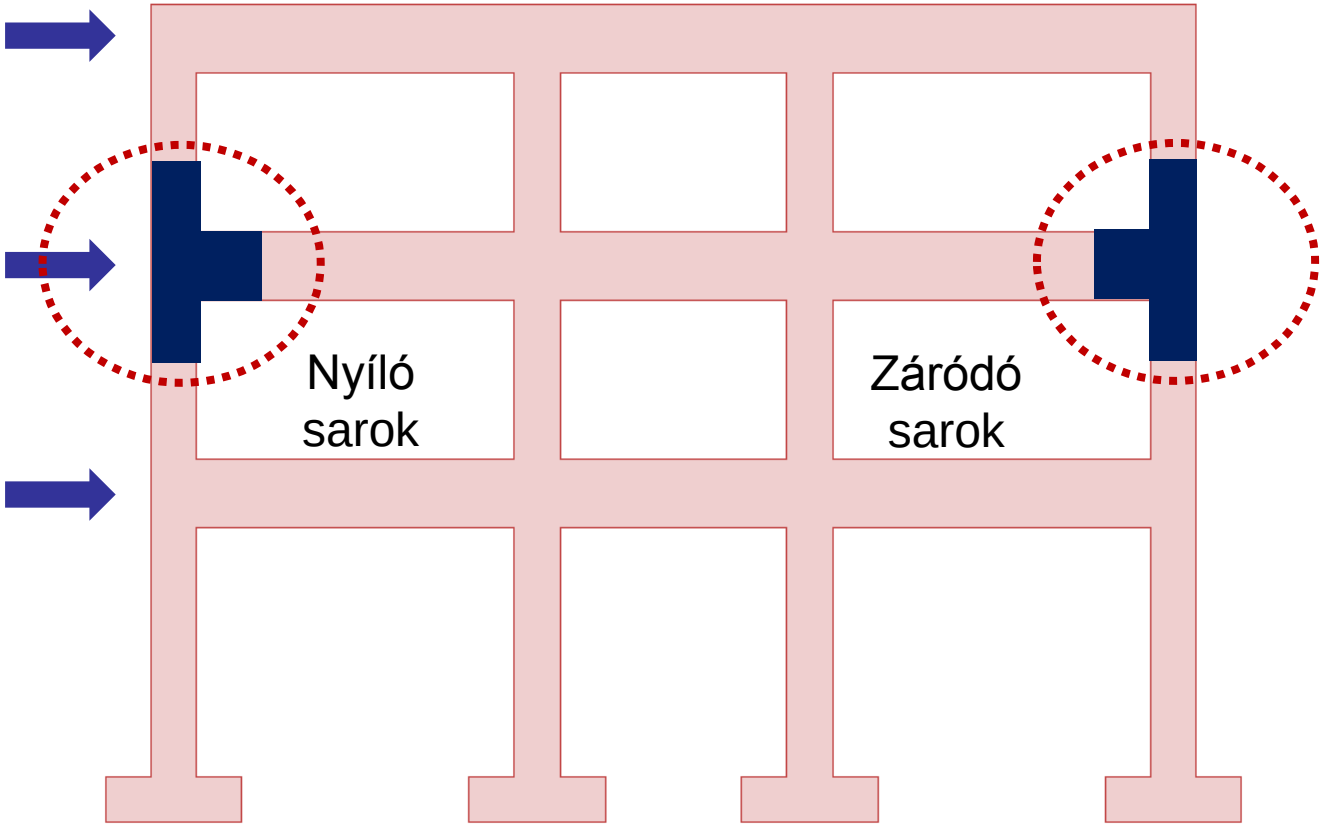
Rigid column-beam joint for multistory RC frame V.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata V.



Merevítetlen keret szélső pillér-gerenda merev kapcsolata

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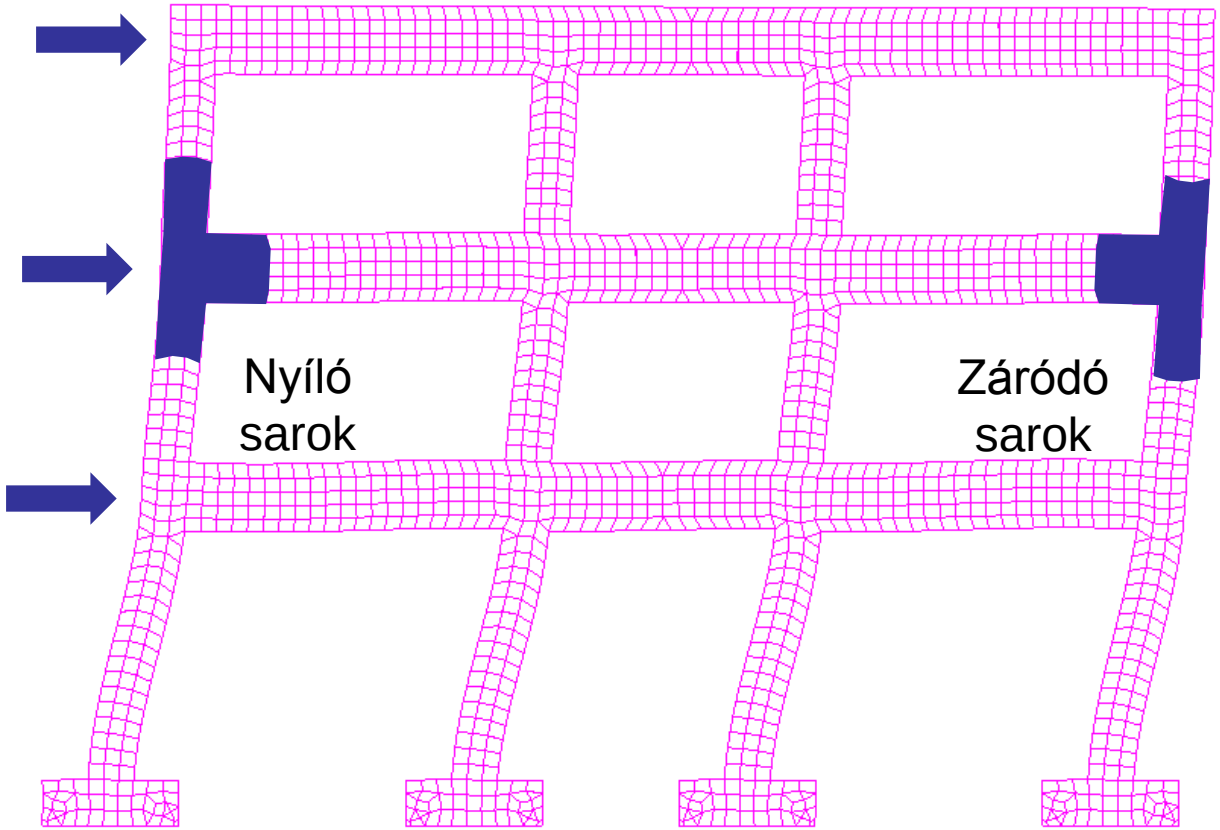
Rigid column-beam joint for multistory RC frame IV.

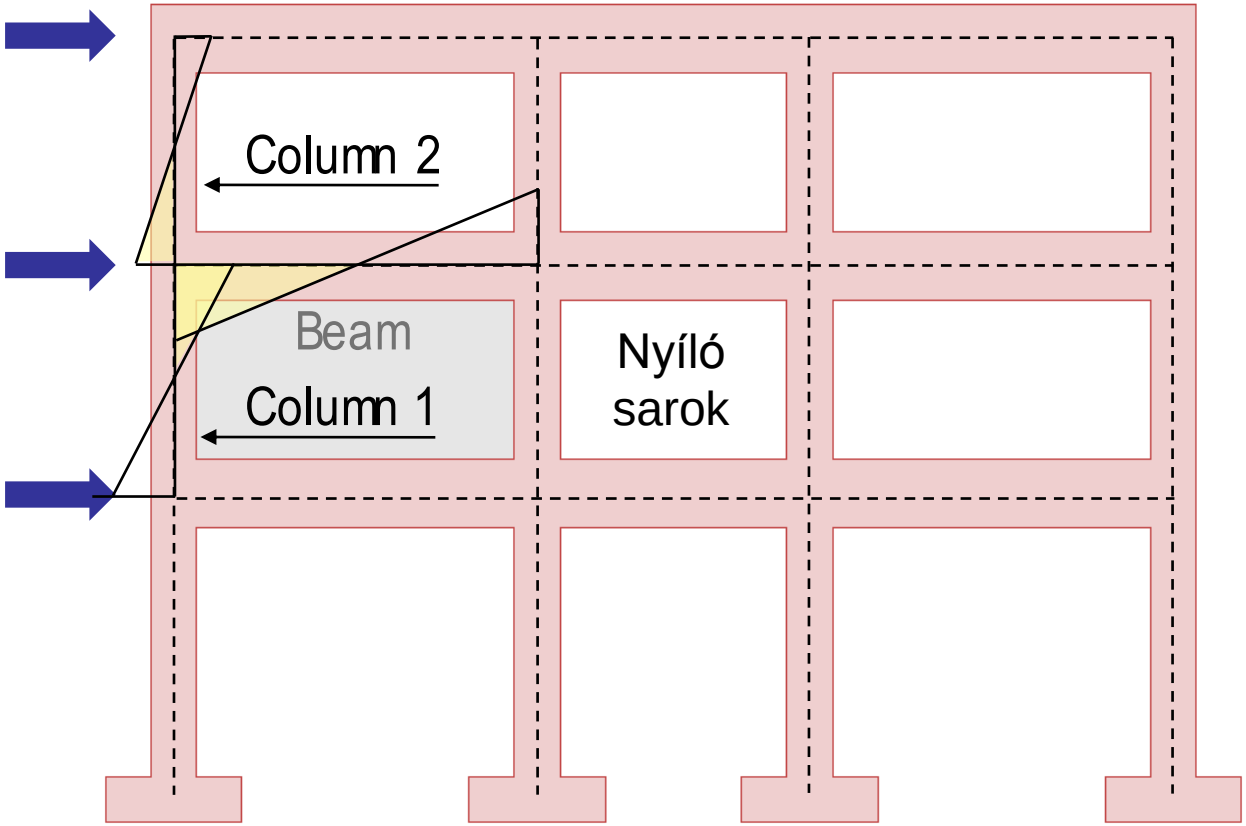
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata IV.



Merevítetlen keret közbenső pillér-gerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame V.

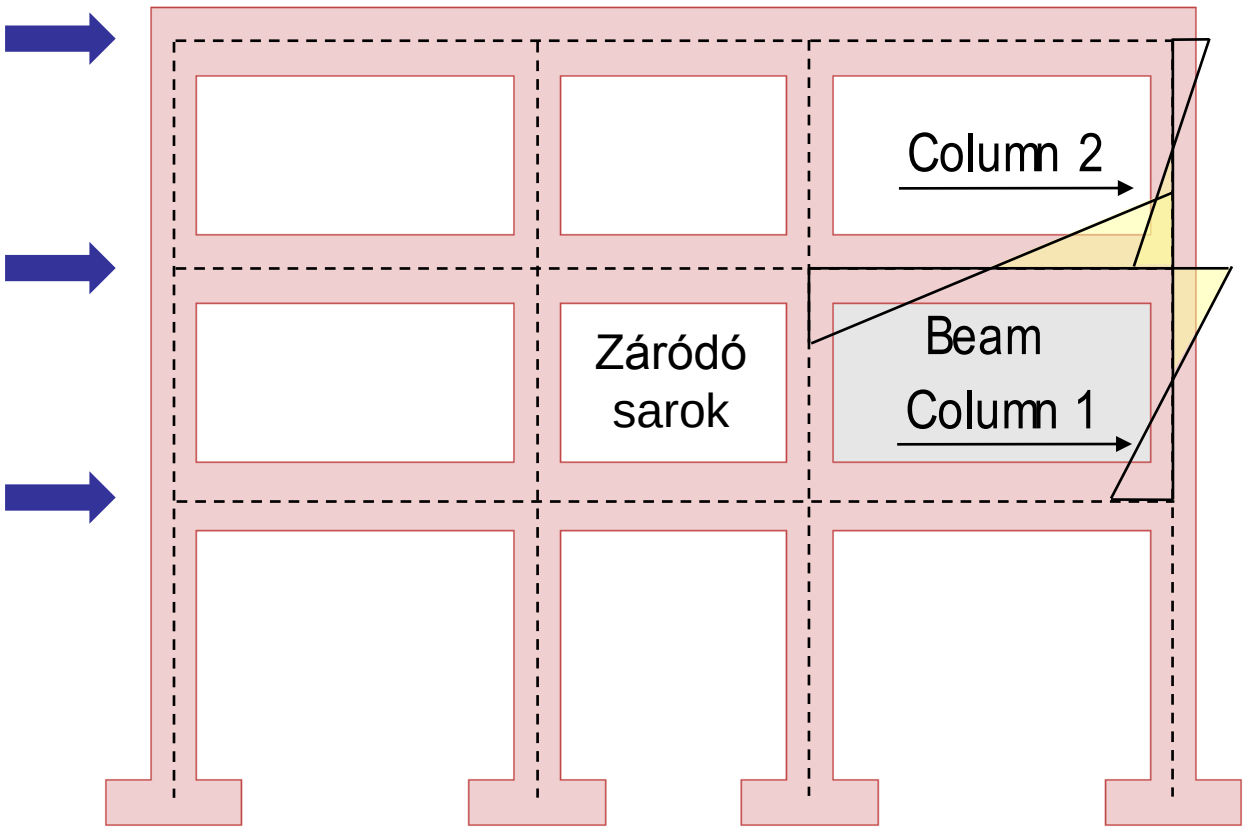
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata V.



Merevítetlen keret szélső pillér-gerenda merev kapcsolata

Rigid column-beam joint for multistory RC frame VI.

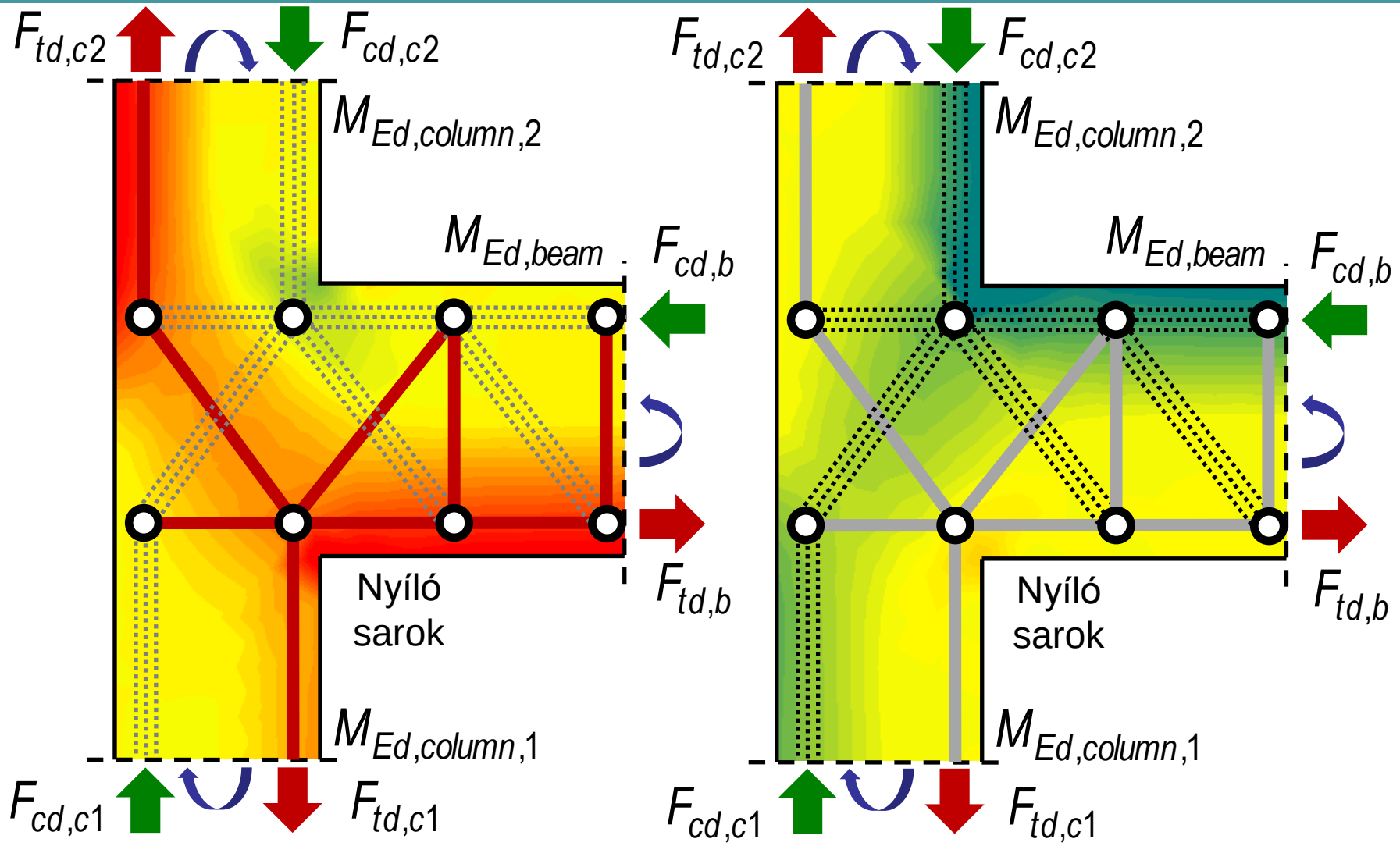
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata VI.



Merevítetlen keret szélső pillér-gerenda merev kapcsolata

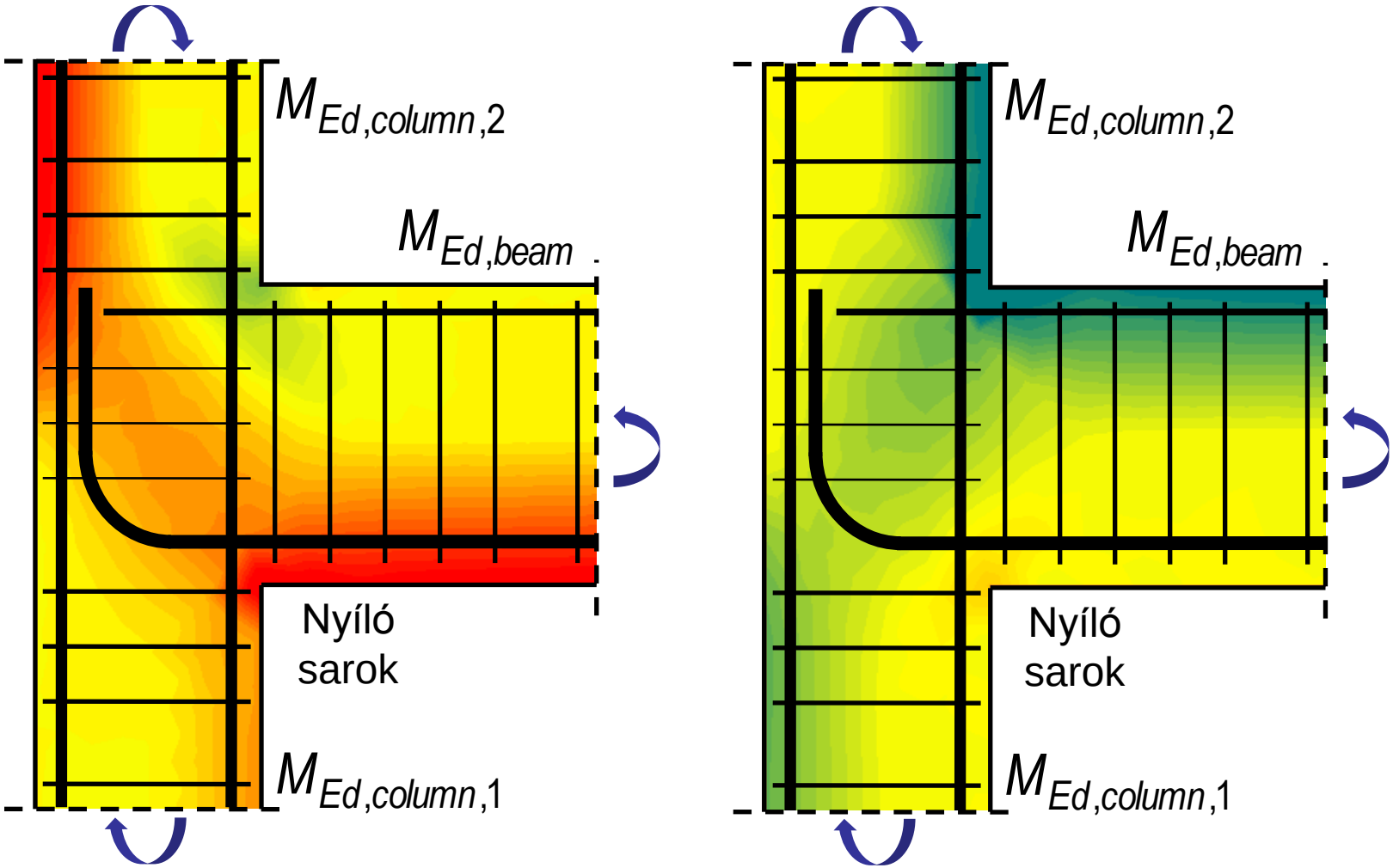
Rigid column-beam joint for multistory RC frame V.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata V.



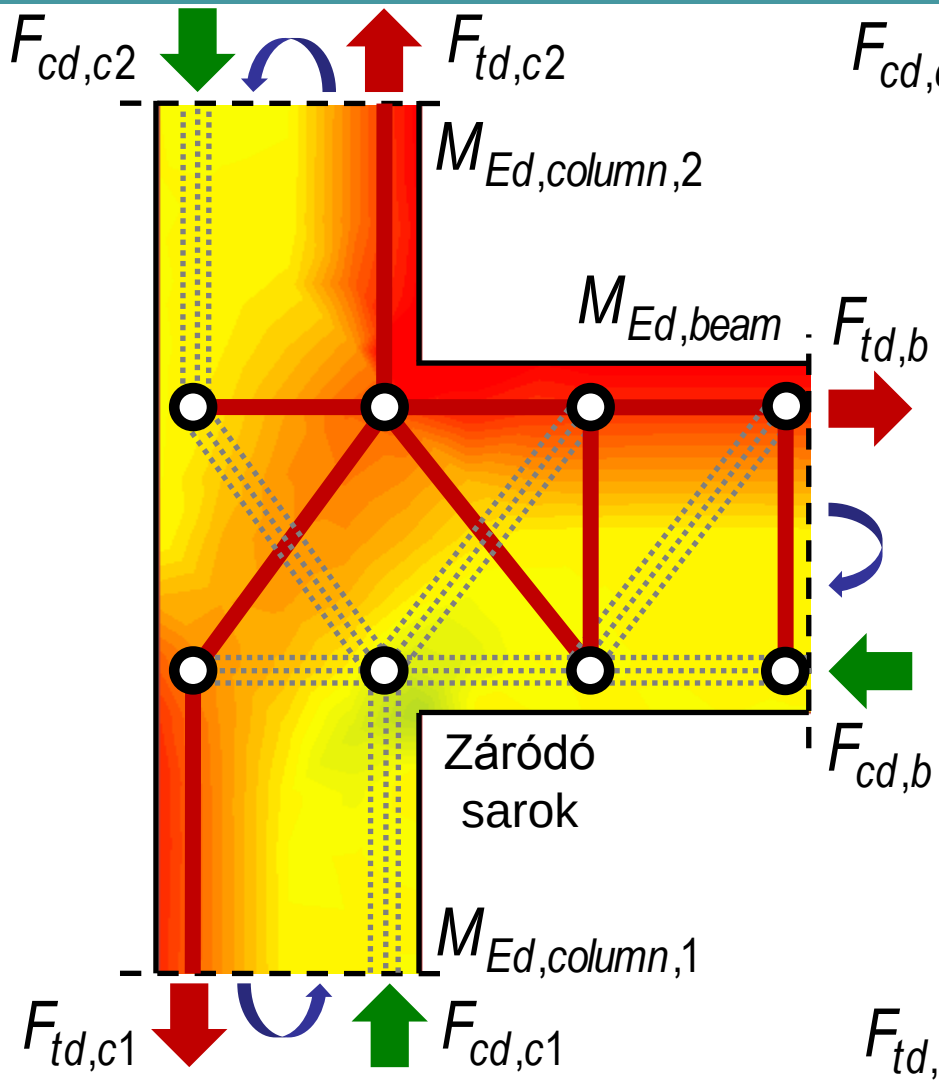
Rigid column-beam joint for multistory RC frame V.

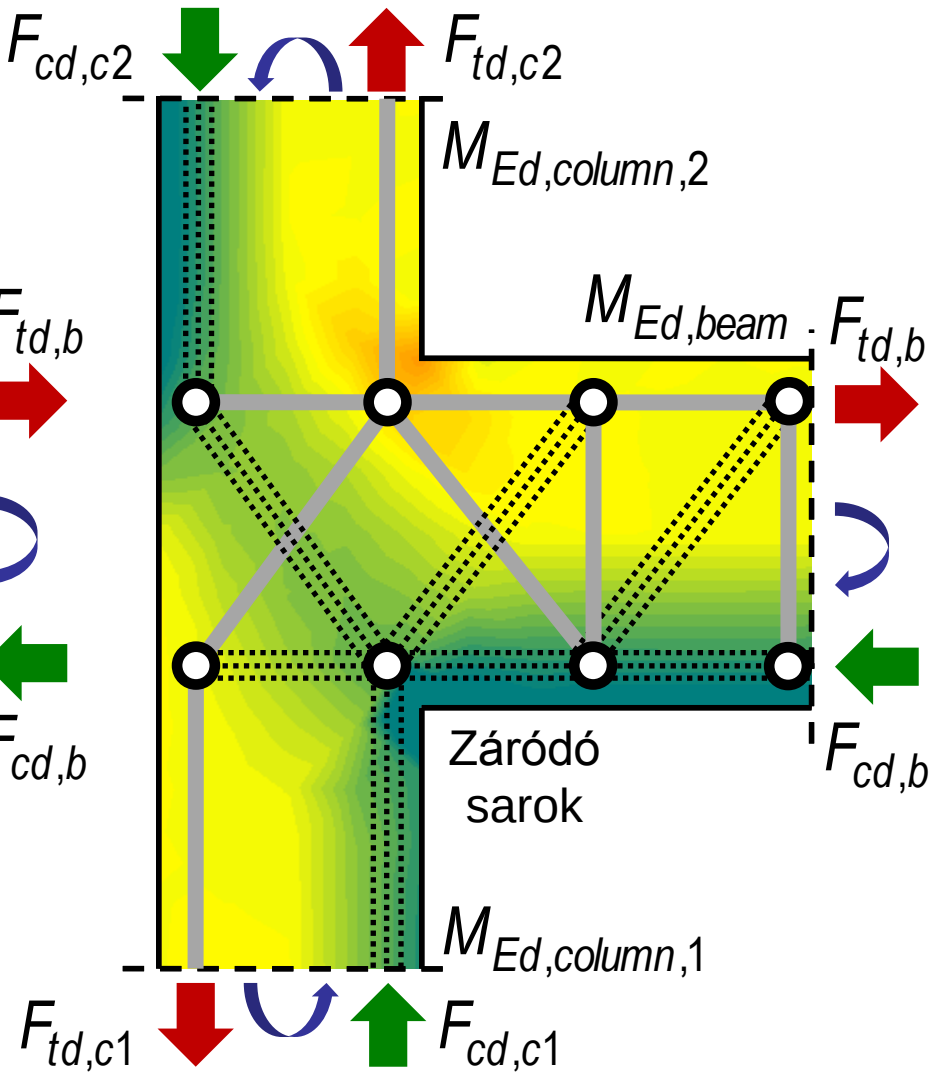
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata V.



Rigid column-beam joint for multistory RC frame VI.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata VI.





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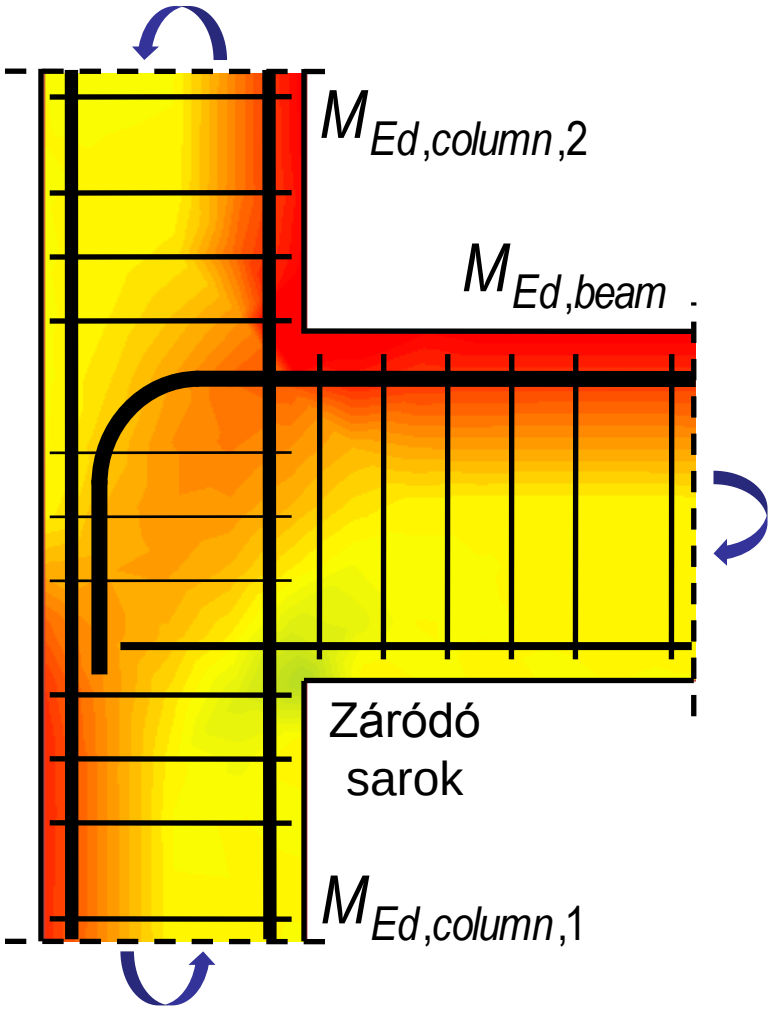
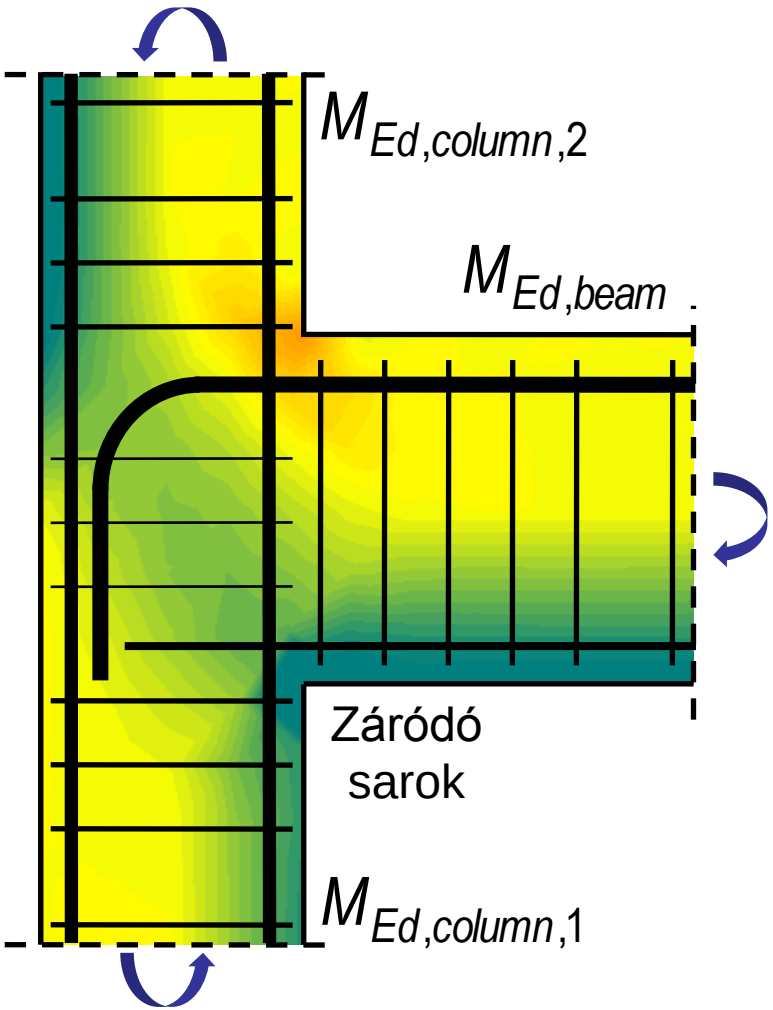
Rigid column-beam joint for multistory RC frame VI.

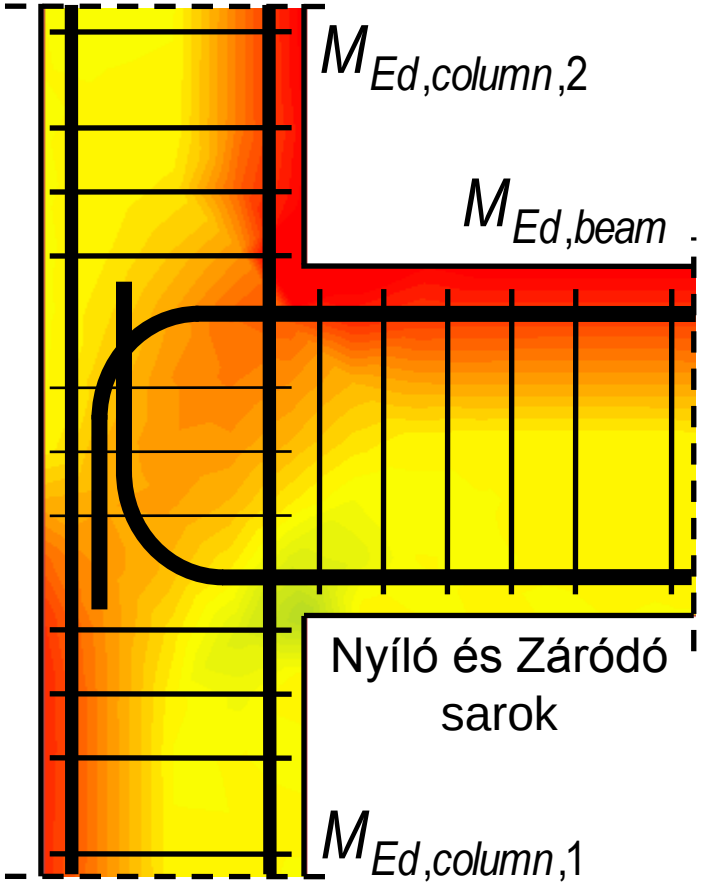
Többszintes vasbeton keret merev oszlop-gerenda kapcsolata VI.

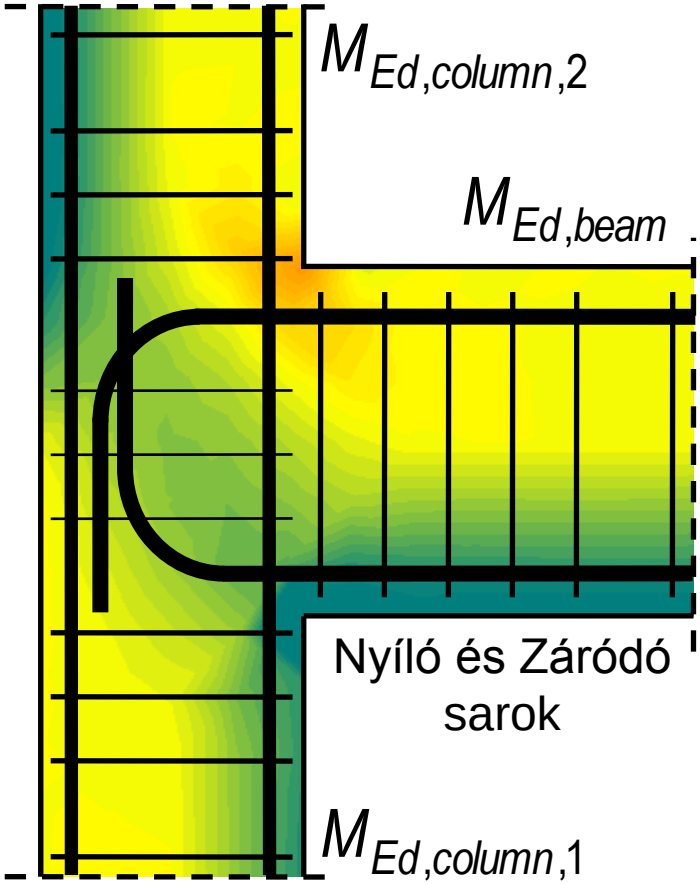




Rigid column-beam joint for multistory RC frame VII.

Többszintes vasbeton keret merev oszlop-gerenda kapcsolata VII.



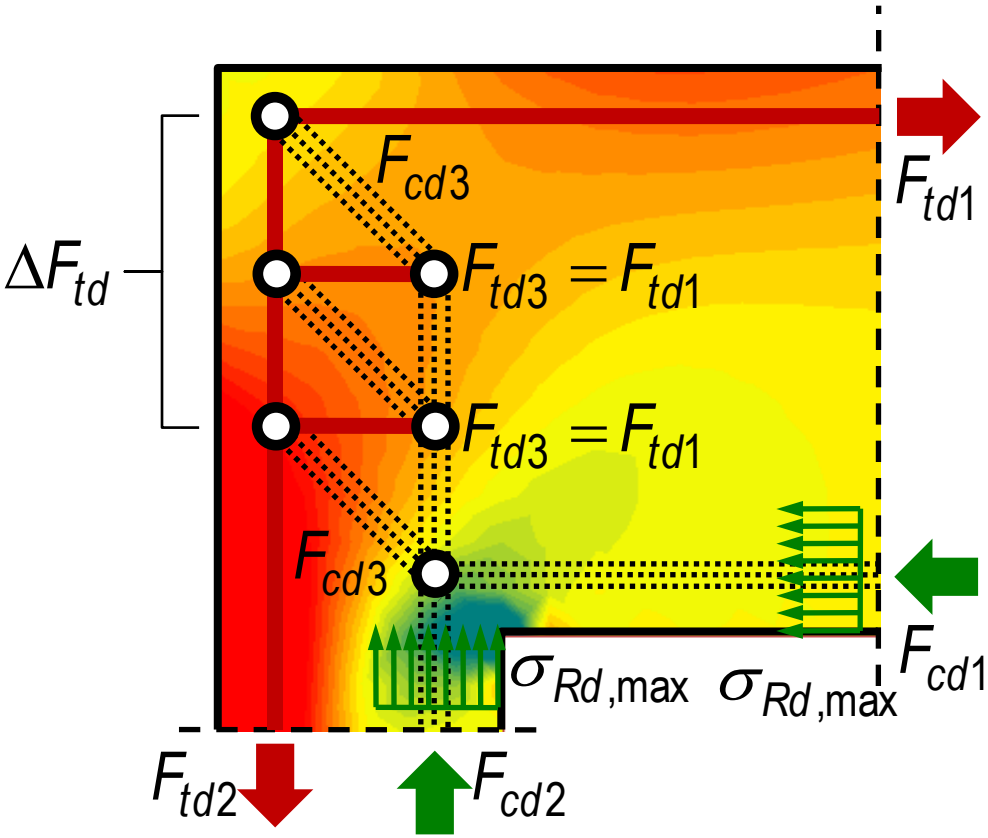


VII.

Reinforced Concrete Structures III.

Vasbetonszerkezetek III.

- Rúdszerkezetek, keretek csomóponti kialakításai, szerkesztési szabályok I. -



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