**TRUSS – 2D and 3D v1.01**

*Name of program:* ***ThreeDTruss***

The program calculates the longitudinal bar forces in a 2-dimensional or 3-dimensional truss. The input consists of four parts: ***1.)*** input of node coordinates, ***2.)*** input of bars and their definition by start node n**i** and end node n**k**, ***3.)*** definition of supported nodes and **4.)** joints loaded by forces **Fx,Fy,Fz**. Then the program builds up the matrix[(*nb*+*nr*),(*nb*+*nr*+*1*)] of the equations of equilibrium for ***nb*** bars and ***nr*** support reactions of the entire system and solves it by means of the RREF-command. The orientation of the coordinates for a two-dimensional problem is a *x–y* – system y

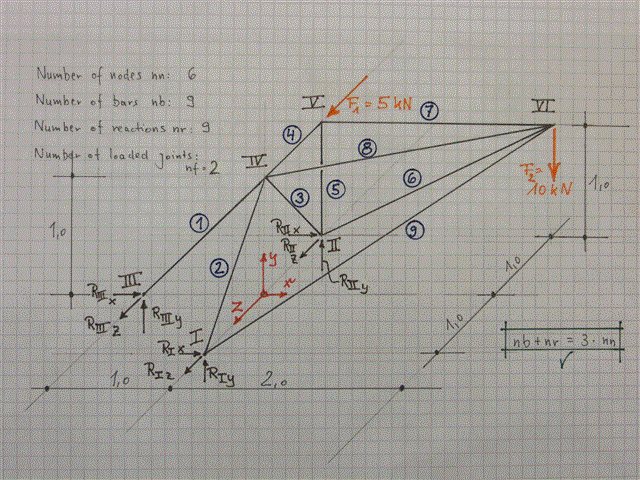
x

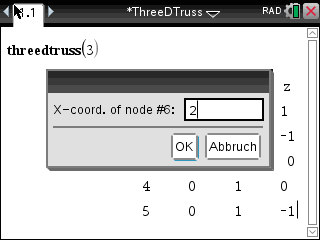
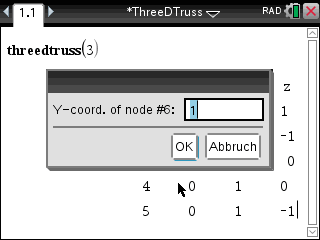
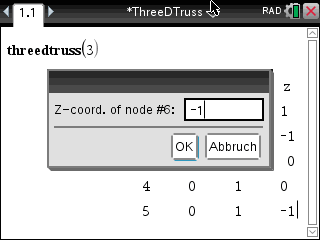
or a system *x – y – z* orientated according to the right-hand rule as shown in *fig*. *1* of the 3-D-example ( thumb points to ***x***, forefinger: ***y***, middle-finger: ***z*** ).

There are three ways to run the program. **ThreeDTruss(2)** starts the input and calculation for a two-dimensional system, where all z-inputs and –outputs are 0, **ThreeDTruss(3)** does the same for a system defined in a x-y-z – system and **ThreeDTruss(0)** offers the opportunity to analyze a new load case for a recently calculated system still being stored.

The execution is demonstrated for the example depicted in *fig. 1* defined by **6** nodes, **9** bars, **9** support reactions and **2** loaded nodes. The input of data of a 2-D-system applies in the same way except that the inputs bearing index …z are omitted.

Load *ThreeDTruss* to the TI-*nspire*, then select *My Documents* and start **ThreeDTruss**. Press the var-key, select **threedtruss()** andcomplete to **threedtruss(3).** The screen now asks for the input of number of nodes ***nn*** , number of bars ***nb***, number of support reactions ***nr***, and number of loaded joints ***nf***, where a joint may have up to three loads.

* fig. 1)*

*fig. 2.) fig. 3) fig.4)*

The criterion for a 3-D-system statically determinate is met: ***nr*** + ***nb*** = 3\****nn*** 9+9 = 3\*6. Now enter for each node its coordinates ***x, y, z*** referred to the chosen coordinate system as listed in *Table 1* and demonstrated for node 6 in *fig. 2–4*). Part ***3.)*** of the input routine is the entry of start node n**i** and end note n**k** for each member of the truss according to *table 2* and *fig. 5-6*) as shown for member 2. The next entry defines the nodes bearing a fixed support, indicated by a ***1*** for the corresponding coordinate (*table 3* , demonstrated for node 3 in *fig. 7-10)*. You may also input ***-1***, the result for this support will then be displayed with changed sign. At last the input of the joints bearing loads ***Fx,Fy,Fz*** occurs (*table 4* , *fig. 11 – 12* as example for ***Fz*** in node 5).

*Node x y z member n****i*** *n****k*** *fixed node x y z*

1 0 0 1 1 3 4 1 1 1 1

2 0 0 -1 2 1 4 2 1 1 1

3 -1 0 0 3 2 4 3 1 1 1

4 0 1 0 4 4 5 *Table 3*: fixed joints

5 0 1 -1 5 2 5

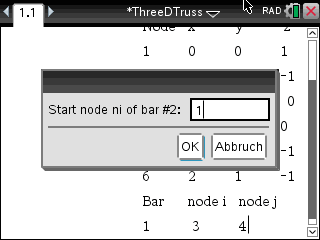
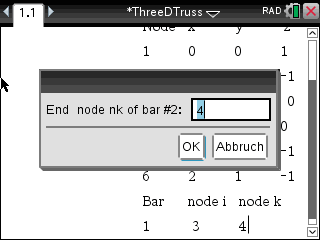
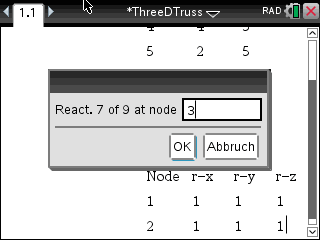
6 2 1 -1 6 2 6 *loaded joints Fx Fy Fz*

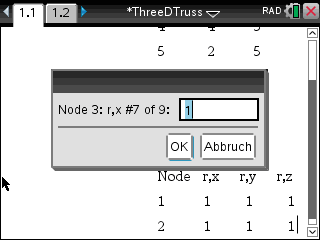
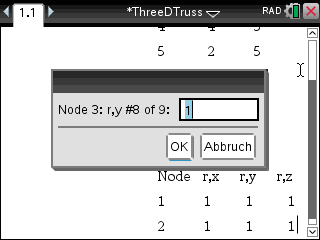
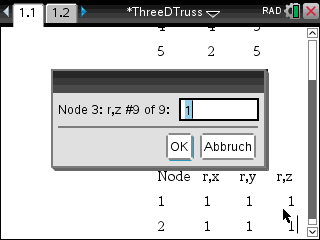
7 5 6 5 0 0 5

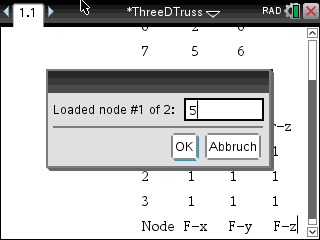
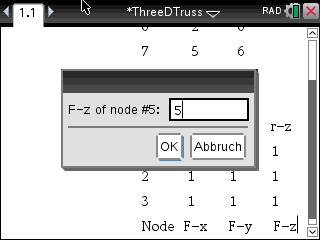
*Table 1* : node coordinates 8 4 6 6 0 -10 0

9 1 6 *Table 4*: loaded joints

*Table 2*: member - end nodes

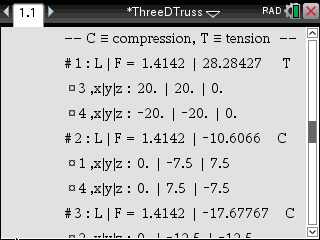
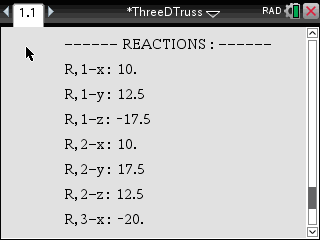
*fig. 5.) fig. 6)  fig.7)*

*fig. 8.) fig. 9) fig. 10)*

* fig. 11* * fig.12*)

Output are the bar ***L***engths and -***F***orces (*fig.13*), the last of which are | + | , | - |

**T**ension **C**ompression

** *fig.13*)  *fig.14*)

positive acting away from nodes, negative towards nodes. Line 2 and 3 of each bar display the force components ***Fx, Fy, Fz*** for both nodes. E.g. the Fx- and Fy-vectors of member 1, node 4 both have the value -20, as acting away from that node towards negative x- and y-coordinate.

The last screen (*fig. 14*) depicts the reaction forces ***R,n-i*** ,where ***n*** indicates the node and ***i***stands for the appropriate coordinate. To analyze another load case, start **threedtruss(0)**,then enter the amount of loaded nodes and the affected node numbers followed by their ***Fx, Fy, Fz***.

**HINTS and WARNING**

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