**FRAMEWORK – 2D and 3D v1.01**

*Name of program:* ***Framework***

The program finds the member forces in a 2-dimensional (*Frame2D*) or 3-dimensional framework (*Frame3D*) by a successive calculation from node to node of the truss. The orientation of the coordinates is a x – y - system for *Frame2D* : y or a system x – y – z ( *Frame3D* )

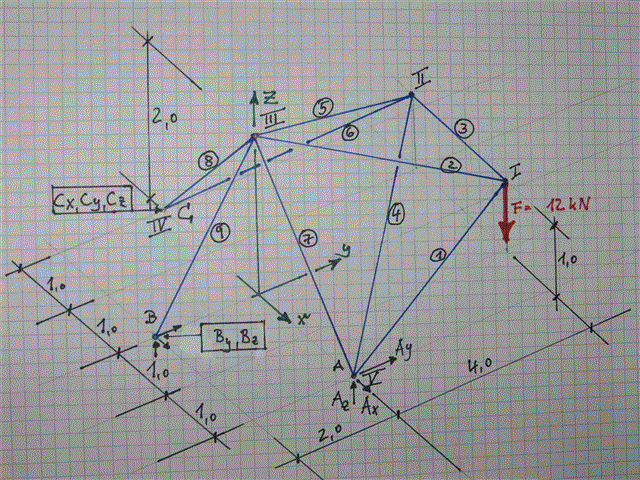
x

orientated according to the right-hand rule as shown in *fig*. *1* of the example ( thumb points to ***x***, forefinger: ***y***, middle-finger: ***z*** ). The input occurs in three main parts ( informations and numbers set in brackets in the following descriptions refer to *Frame3D* ):

1. Starting from node ***i*** with 2 (3) connected bars enter their length components Lx, Ly (, Lz).
2. After the input of the second (third) bar the program prompts for the input of a force ***F*** acting in node ***i*** , which is described by its components ***Fx***, ***Fy*** (, ***Fz***)
3. Enter the number # of each member connected to node ***i*** that has been already calculated. This last item does not apply for the first three member of your calculation and is omitted in that case, cf. example!

The input is demonstrated in detail by the example of the 3D-truss depicted in *fig*. 1 . The input of data of a 2D-system applies in the same way except that the values bearing index …z are omitted.

Load *Framework* to the Prime, start *Framework* from the toolbox, select *Frame3D* and press Enter. Start the calculation at node **I** having 3 unknown bars connected. The program now prompts for the input of the first bar and its length components Lx, Ly and Lz, indicating “Input 1 of 3” in the topline of the screen. These components have to be input positive, if they are orientated from the starting node towards positive coordinate directions. For member #1 starting at node **I** these quantities are Lx = 1, Ly = -4, Lz = -1 (*fig. 1*).

  *fig. 1)*

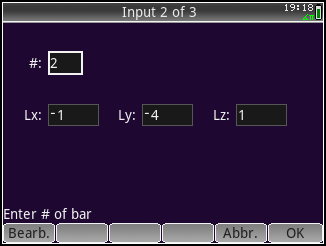
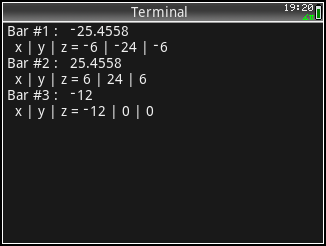
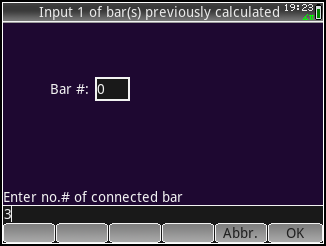
So, according to item ***1.)*** above mentioned, enter in the corresponding fields: **#:** 1, then touch OK or press Enter , **Lx:** 1 OK **Ly:** -4 OK **Lz:** -1 OK OK.

Proceed in the same way for the remaining bars 2 and 3 at node **I**  (*fig.* *2*):

**#:** 2 OK **Lx:** -1 OK **Ly:** -4 OK **Lz:** 1 OK OK , **#:** 3 OK **Lx:** -2 OK **Ly:** 0 OK **Lz:** 0 OK OK. Now the program prompts for the input of any external force acting in node **I (** item ***2.)*** ). The input has to be: **Fx:** 0 OK **Fy:** 0 OK **Fz:** -12 ( acting opposite to positive z !) OK OK . As these are the first bars of the calculation, item ***3.)*** is omitted and the Prime displays the result (*fig. 3*), where the first line of each member displays the bar force (positive for tension, negative for pressure) and the second line its components in x, y, z – direction at node **I**.

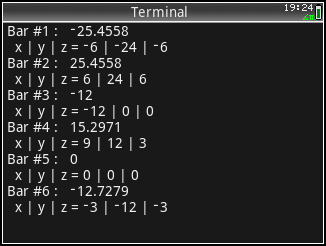
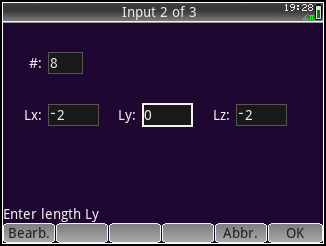
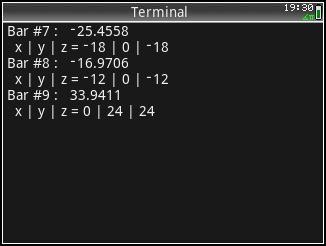
Press Enter to continue the input for node **II** and members #4, #5, #6 according to item ***1.)***:

**#:** 4 OK **Lx:** 3 OK **Ly:** -4 OK **Lz:** -1 OK OK , **#:** 5 OK **Lx:** 1 OK **Ly:** -4 OK **Lz:** 1 OK OK, **#:** 6 OK **Lx:** -1 OK **Ly:** -4 OK **Lz:** -1 OK OK. As there is no force acting in **II** and **Fx** = **Fy**  = **Fz** = 0 by default, press only Enter to skip to item ***3.)*** . The screen prompts for input 1 of connected bars already found (*fig. 4*). Enter 3 in the Bar#: - field and touch OK or press Enter. As this is the only calculated member on this node, again press only OK or Enter ( Bar#: 0 by default !).

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

Now the result for members #4, #5, #6 is displayed (*fig. 5*). Carry on with bars #7, #8, #9 starting at node **III** (*fig. 6* illustrates #8 ): **#:** 7 OK **Lx:** 2 OK **Ly:** 0 OK **Lz:** -2 OK OK , **#:** 8 OK **Lx:** -2 OK **Ly:** 0 OK **Lz:** -2 OK OK, **#:** 9 OK **Lx:** 0 OK **Ly:** -2 OK **Lz:** -2 OK OK. Item ***2.)*** requires no input, press only Enter or touch the OK-field. In the next screen enter **Bar#:** 2 OK for the first bar already found and connected to node **III**, then **Bar#:** 5 OK OK . The result is displayed as depicted in *fig 7)*.

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

Press Enter to return to the input of bar lengths. To find the reaction forces at support A, proceed as follows: name **Ax** as **bar# 10**, **Ay** as **bar# 11** and **Az** will be **bar# 12**. Now enter for the lengths Lx, Ly, Lz: **#10**: 1 0 0, **#11**: 0 1 0, **#12**: 0 0 1. Item ***2.)*** requires no input, press only Enter or touch the OK-field and in the next screen enter **Bar#:** 1 OK **Bar#:** 4 OK **Bar#:** 7 OK OK. This yields the result: (Ax = ) **Bar#10: -15**,(Ay = ) **Bar#11: 12**,(Az = ) **Bar#12: 21**. Press Enter to return to input item ***1.)***. With ***0*** being in the **#:** - field as default press Enter or OK to conclude the program and to return to the Home-screen displaying the list of all member forces.

**HINTS and WARNING**

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