Buckling with Gravitational Load

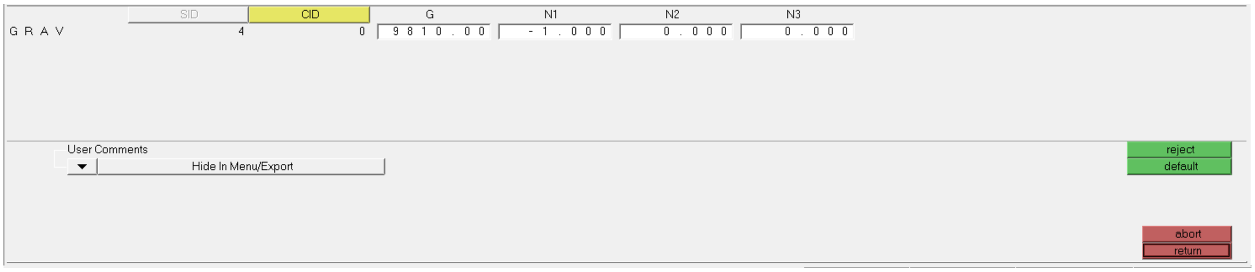
Typically, the critical load factor is determined with respect to all loads defined in the referenced linear static loadcase (referenced by **STATUSB**).

In case the critical load factor should only be applied to variable loads (e.g. pressure, forces) and NOT to gravitational load (constant load), the two procedures/techniques described below may be employed.

Working Procedure A

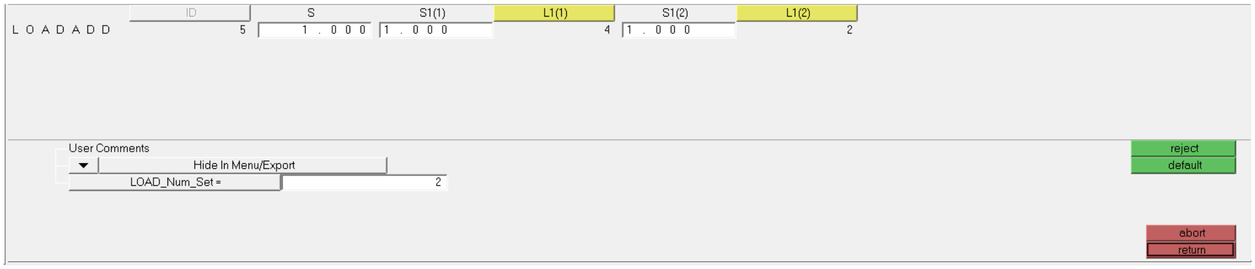
In case gravitational and variable loads are to be considered, the following load collectors are required:

- Load Collector for variable loads (here named **force**; no Card Image needed)
- Load collector for gravity (Card Image **GRAV**; remind the system units)



	SID	CID	G	N1	N2	N3
GRAV	4	0	9810.00	-1.000	0.000	0.000

- Load collector combines variable and constant loads (Card image **LOAD** needed; here named: **gravity_and_force**).



	ID	S	S1(1)	L1(1)	S1(2)	L1(2)
LOADADD	5	1.000	1.000	4	1.000	2

LOAD_Num_Set = 2

In the Card Image above, **L1(1)** is linked to the gravity load collector, **L1(2)** refers to the variable load (in this case, **force**). **S**, **S1(1)** and **S1(2)** are scale factors, respectively.

In addition, we have a load collector for the model constraints (here named **SPC**, no Card Image needed) and a load collector which defines the number of eigenmodes to be extracted (Card Image **EIGRL**, here the load collector is named **EIGRL**)

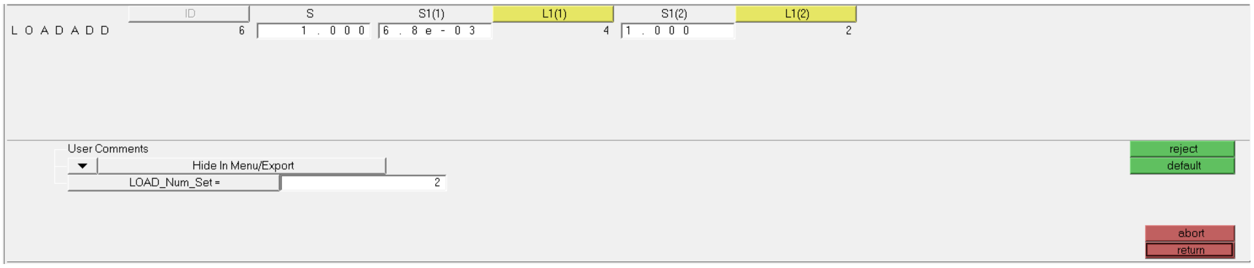
Step 1:

Determine the critical load factor for all loads (constraint and variable loads). We may call this critical load factor buckling_all (i.e. run the buckling analysis taking into account all loads)

Step 2:

Scale the constant load, **L1(1)**, by adjusting the scale value of **S1(1)** in the Card Image of the load collector:

S1(1) = 1 / [critical load factor “buckling_all”]



	ID	S	S1(1)	L1(1)	S1(2)	L1(2)
LOADADD	6	1.000	6.8e-03	4	1.000	2

User Comments

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LOAD_Num_Set = 2

The scale factor for **S1(2)** of the variable load **L1(2)** remains unchanged i.e. **S1(2)** = **1.0**

Step 3:

Run the buckling analysis with the newly scaled value for the gravity load, **L1(1)**. We call this additional buckling analysis and critical load factor, **A_buckl_grav_force.**

Provided that the buckling factor **A_buckl_grav_force** equals **buckling_all**, everything is fine because then:

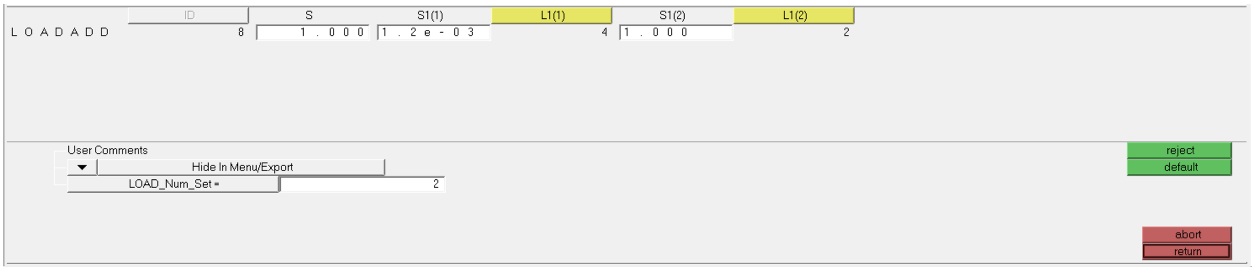
gravitational load **L1(1) = L1(1)** / [critical load factor **buckling_all**] * [critical load factor **A_buckl_grav_force**]

However, if **A_buckl_grav_force** ≠ **buckling_all** then Step 2 to Step 3 must be repeated iteratively.

Now the **gravity** load **L1(1)** is scaled by **A_buckl_grav_force**:

S1(1) = 1 / [**A_buckl_grav_force**]

This will lead to another buckling value which may be called **B_buckl_grav_force** and so on.



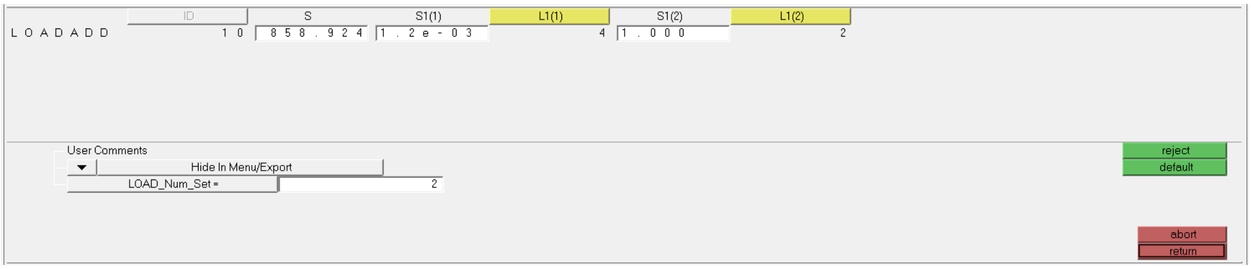
	ID	S	S1(1)	L1(1)	S1(2)	L1(2)
LOADADD	8	1.000	1.2e-03	4	1.000	2

User Comments

Hide In Menu/Export

LOAD_Num_Set = 2

Eventually, when the new (e.g. **C_buckl ...**) buckling factors are equal, an additional review buckling analysis can be carried out. In this analysis, ALL loads are scaled by the last buckling factor e.g. **C_buckl ...**



	ID	S	S1(1)	L1(1)	S1(2)	L1(2)
LOADADD	10	858.924	1.2e-03	4	1.000	2

User Comments

Hide In Menu/Export

LOAD_Num_Set = 2

This buckling analysis will then depict a buckling factor very close to ± 1.

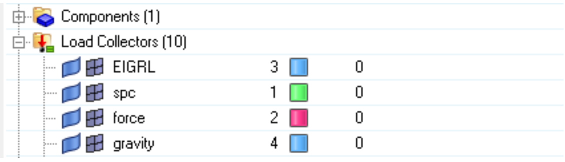
(you can review the above prescribed steps in the example file: prestressed_grav.hm)

Working procedure B

Starting with the RADIOSS solver the above described process becomes much easier and mores straight forward.

In addition to the load collector **spc** and **EIGRL** (see above), we now need the two load collectors:

- Load collector for variable loads (here named **force**; no Card image needed)
- Load collector for gravity (card Image **GRAV**; remind the system units)



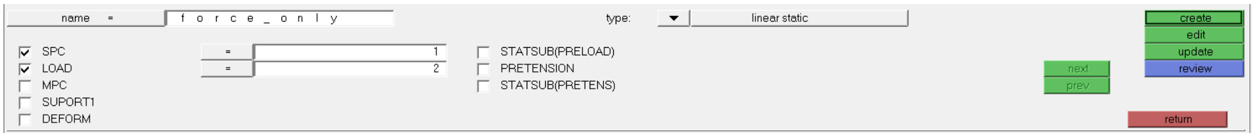
Components (1)

Load Collectors (10)

EIGRL	3	🟦	0
spc	1	🟩	0
force	2	🟥	0
gravity	4	🟦	0

Based on these two load collectors, the two loadcases are defined:

- Loadcase **force_only**

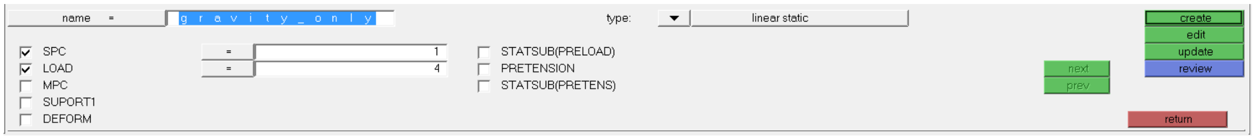


name = force_only type: linear static

☑ SPC = 1
☑ LOAD = 2
□ MPC
□ SUPORT1
□ DEFORM

□ STATSUB(PRELOAD)
□ PRETENSION
□ STATSUB(PRETENS)

- Loadcase **gravity_only**

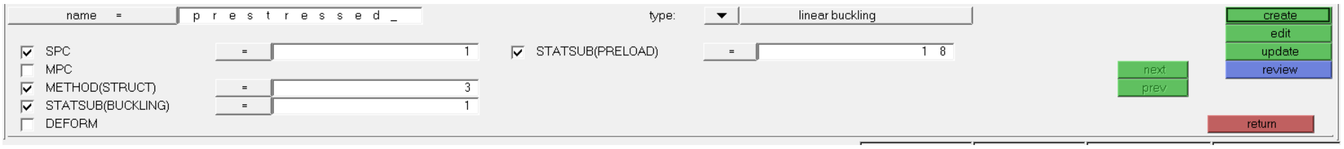


name = gravity_only type: linear static

☑ SPC = 1
☑ LOAD = 4
□ MPC
□ SUPORT1
□ DEFORM

□ STATSUB(PRELOAD)
□ PRETENSION
□ STATSUB(PRETENS)

NOTE: In previous versions we selected type as **generic** but now the **type: linear buckling** has to be selected.



name = prestressed_

type: linear buckling

☑ SPC = 1

□ MPC

☑ METHOD(STRUCT) = 3

☑ STATSUB(BUCKLING) = 1

□ DEFORM

☑ STATSUB(PRELOAD) = 18

As before **SPC** references the model constraints, **METHOD (STRUCT)** references the load collector with card image **EIGRL.**

STATUS (BUCKLING) references **forces_only**

STATUS (PRELOAD) references **gravity_only**

You can view the load collectors and load steps in the file: prestressed_gravity.hm