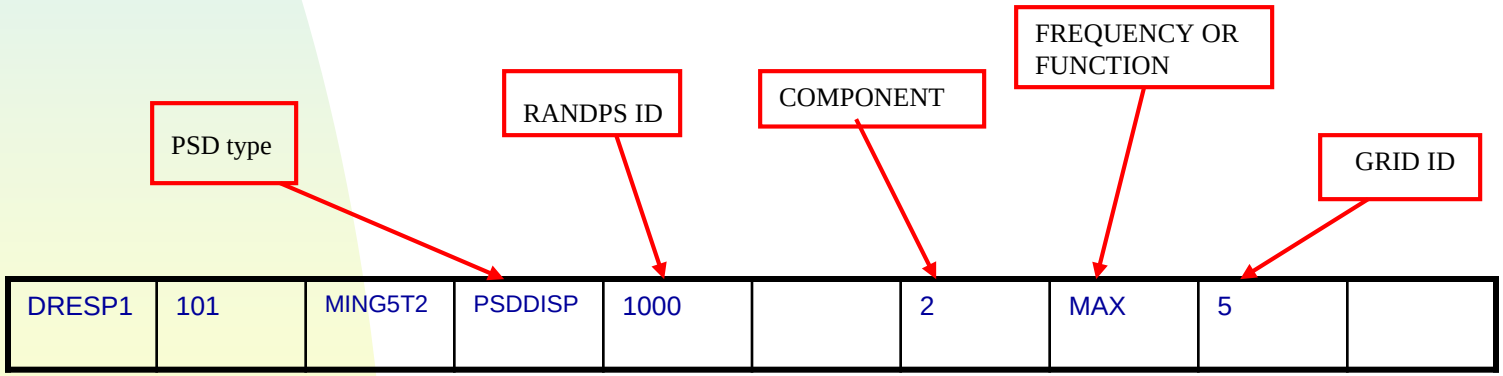
Additional DRESP1 Response Types

- Six new RTYPEs added to the DRESP1
  - Grid point PSD responses (psddisp, psdvelo, psdaccl)
  - Total strain energy for an eigenvalue
  - Grid point forces (gpforce,gpforcp)
- Input on the DRESP1 for the new response types

Response Type (RTYPE)	PTYPE	Response Attributes		
		ATTA (Integer > 0)	ATTB (Integer > 0) or Real > 0.0	ATTi (Integer > 0)
GPFORCE	Grid ID	Component	Blank	Element ID
GPFORCP	Blank	Grid ID	Blank	Orient ID
TOTSE	Blank	Blank	Mode Number	Blank
PSDDISP	RANDPS ID	Component	Frequency (Blank, Real > 0 or Character)	Grid ID
PSDVELO	RANDPS ID	Component	Frequency (Blank, Real > 0 or Character)	Grid ID
PSDACCL	RANDPS ID	Component	Frequency (Blank, Real > 0 or Character)	Grid ID

PSDxxx Response

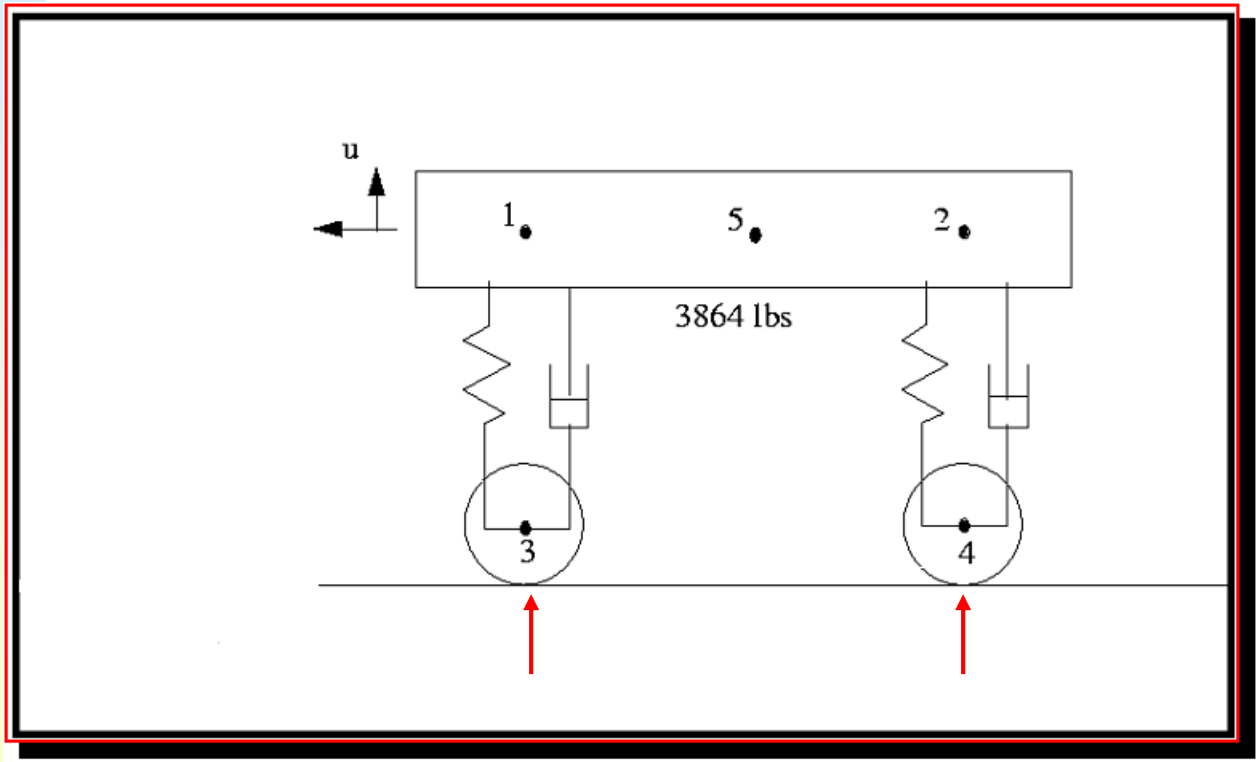
- PSDxxx supports
  - ANALYSIS=MFREQ or DFREQ
  - Augments RMSxxx response introduced in MSC.Nastran 2001
- Input Format:
  - Similar to FRxxx input with the addition of the RANDPS ID in the PTYPE FIELD (field 5)



PSDxxx Response (cont.)

EXAMPLE 1:

- Simplified vehicle model subjected to random loading at the wheels



PSDxxx Response (cont.)

EXAMPLE 1(cont.)

- Optimization Statement
  - Objective Function:
    Minimize the maximum PSD displacement of the vehicle CG across the whole frequency range.
  - Design Variables:
    The suspension components—the shock absorber and spring of the vehicle CBUSH 100 in this case.

    $100 < K < 1000$

    $1.0 < B < 10.$
  - Subject to the following constraints:
    The stresses at the body—CBARs 5 and 6

    $|\sigma| \leq 4500.$

PSDxxx Response (cont.)

EXAMPLE 1 (cont.)

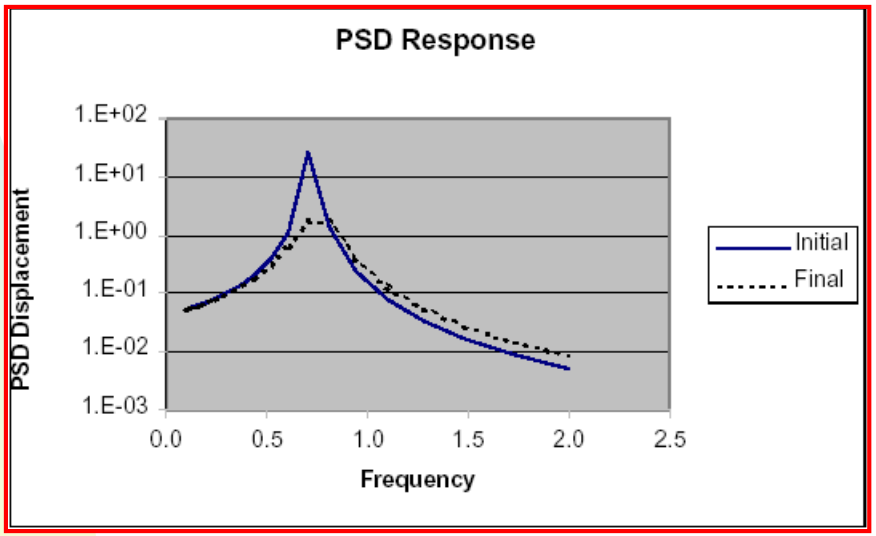
```
SOL 200
CEND
  .
analysis = dfreq
desobj= 101
dessub = 800

SUBCASE 1
  DLOAD = 111
SUBCASE 2
  DLOAD = 112
BEGIN BULK
  .
  .
RANDPS  1000  …
RANDPS  1000  …
  .
```

```
$
$  Rest of analysis model is not shown   $
$   design model
$
desvar,1,k2,1.,0.5,5.
desvar,2,b2,1.,0.5,5.
$
dvprel1,101,pbush,1000,k2,100.
,1,200.
dvprel1,201,pbush,1000,b2,1.
,2,2.0
$
dresp1,101,ming5t2,psddisp,1000,,2,MAX,5
$
dconstr,800,801,-1.e20,4500.
dconstr,800,802,-1.e20,4500.
dresp1,801,e5ptc,frstre,pbar,,12,,11
dresp1,802,e5pte,frstre,pbar,,14,,11
$
doptprm,desmax,20,p1,1,p2,15,iprint,7
,method,3
ENDDATA
```

PSDxxx Response (cont.)

EXAMPLE 1 (cont.):

- The peak PSDDISP at the CG was reduced from 26.6 to 1.71

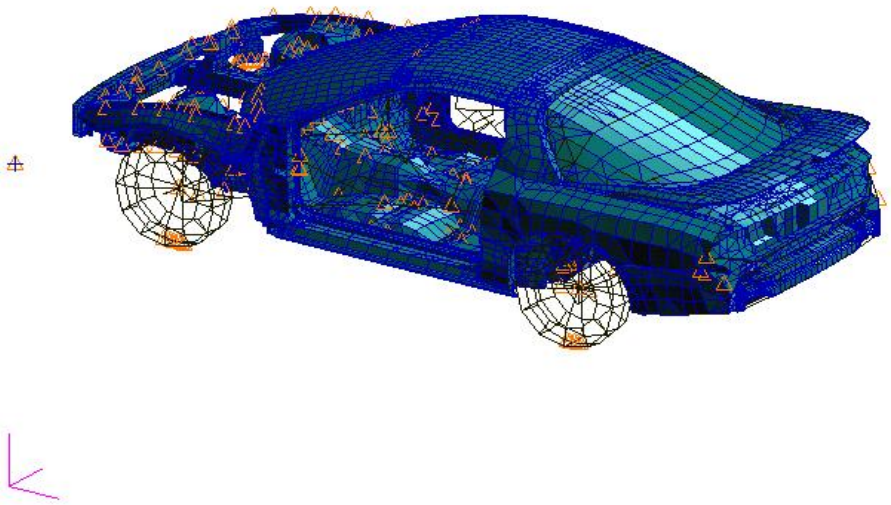


Initial and Final PSD Plots at CG for Simplified Vehicle

PSDxxx Response (cont.)

EXAMPLE 2:

- Vehicle system model
  - 23K grids, 32K elements



PSDxxx Response (cont.)

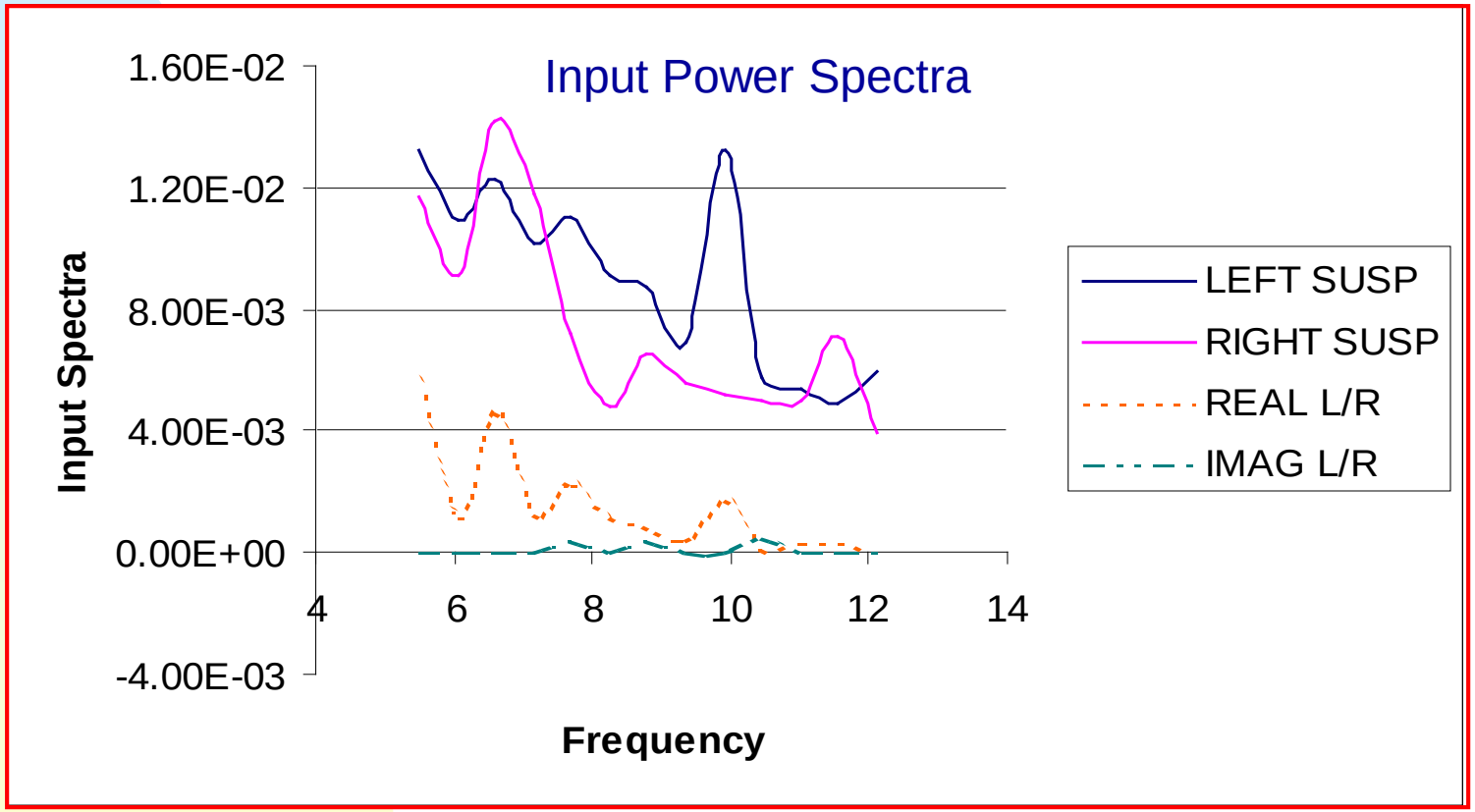
EXAMPLE 2 (cont.):

Optimization Statement:

- Design Variables : spring constants of 9 elastic elements to model engine mount
- Responses : PSD of acceleration at driver's seat, passenger's seat and steering column
- Objective Function:
  - Case A : minimize the sum of RMS acceleration at the driver's seat and passenger's seat
  - Case B : frequency dependent limits on driver's seat is imposed

PSDxxx Response (cont.)

EXAMPLE 2 (cont.):

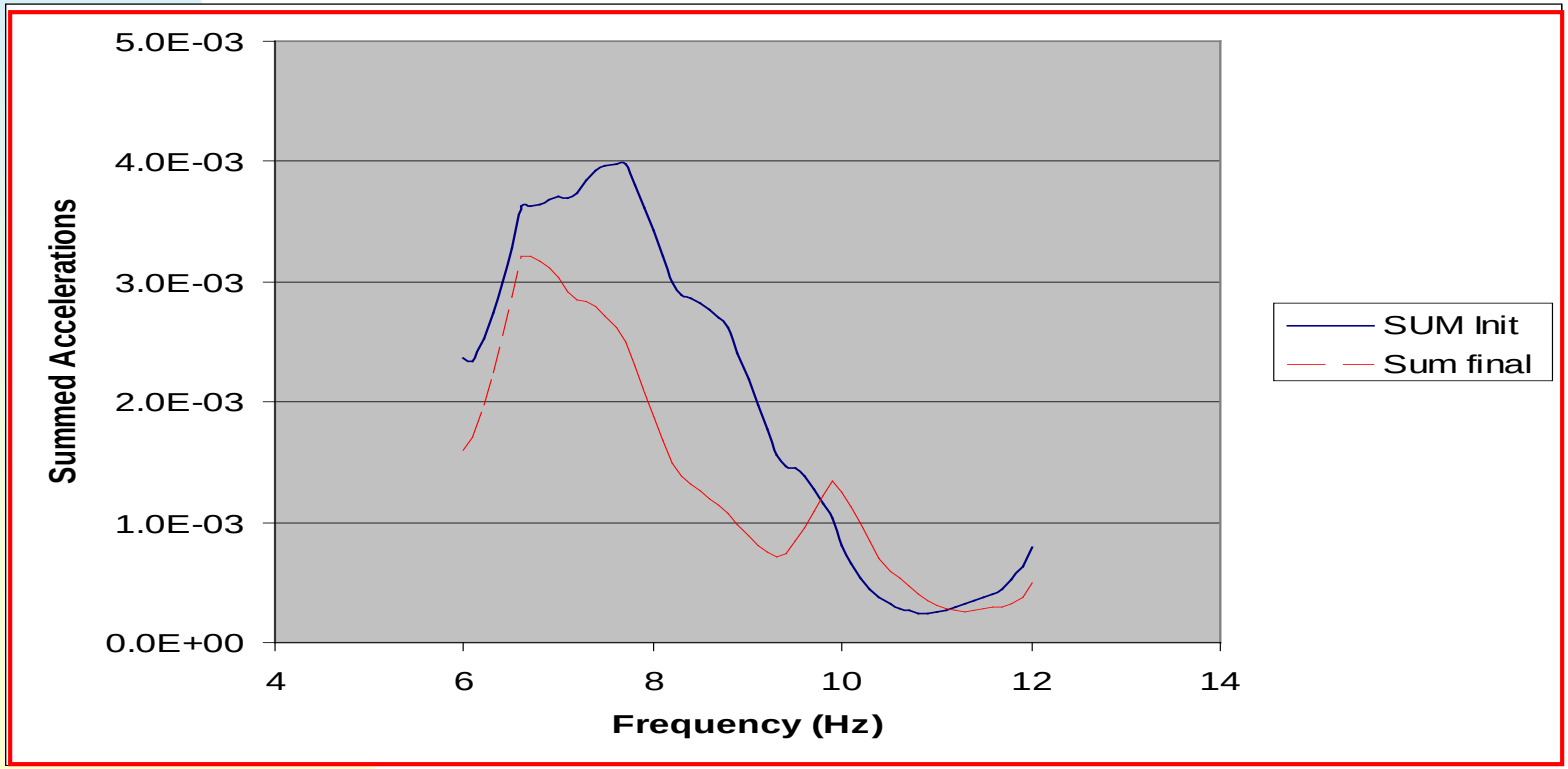


PSDxxx Response (cont.)

EXAMPLE 2 (cont.):

- RMS Reduced from 0.154 to 0.130

CASE A - OBJECTIVE FUNCTION

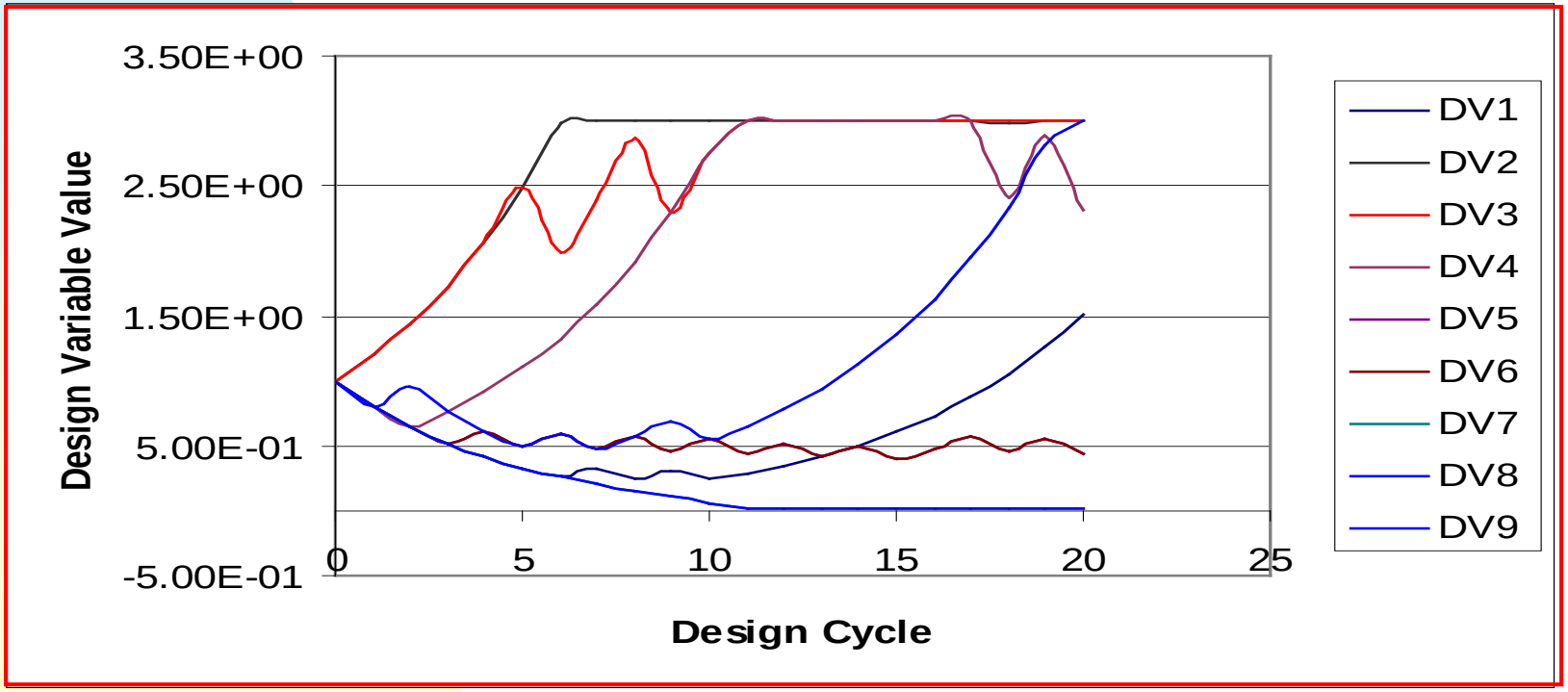


PSDxxx Response (cont.)

EXAMPLE 2 (cont.):

- Many design variables approach their upper bounds

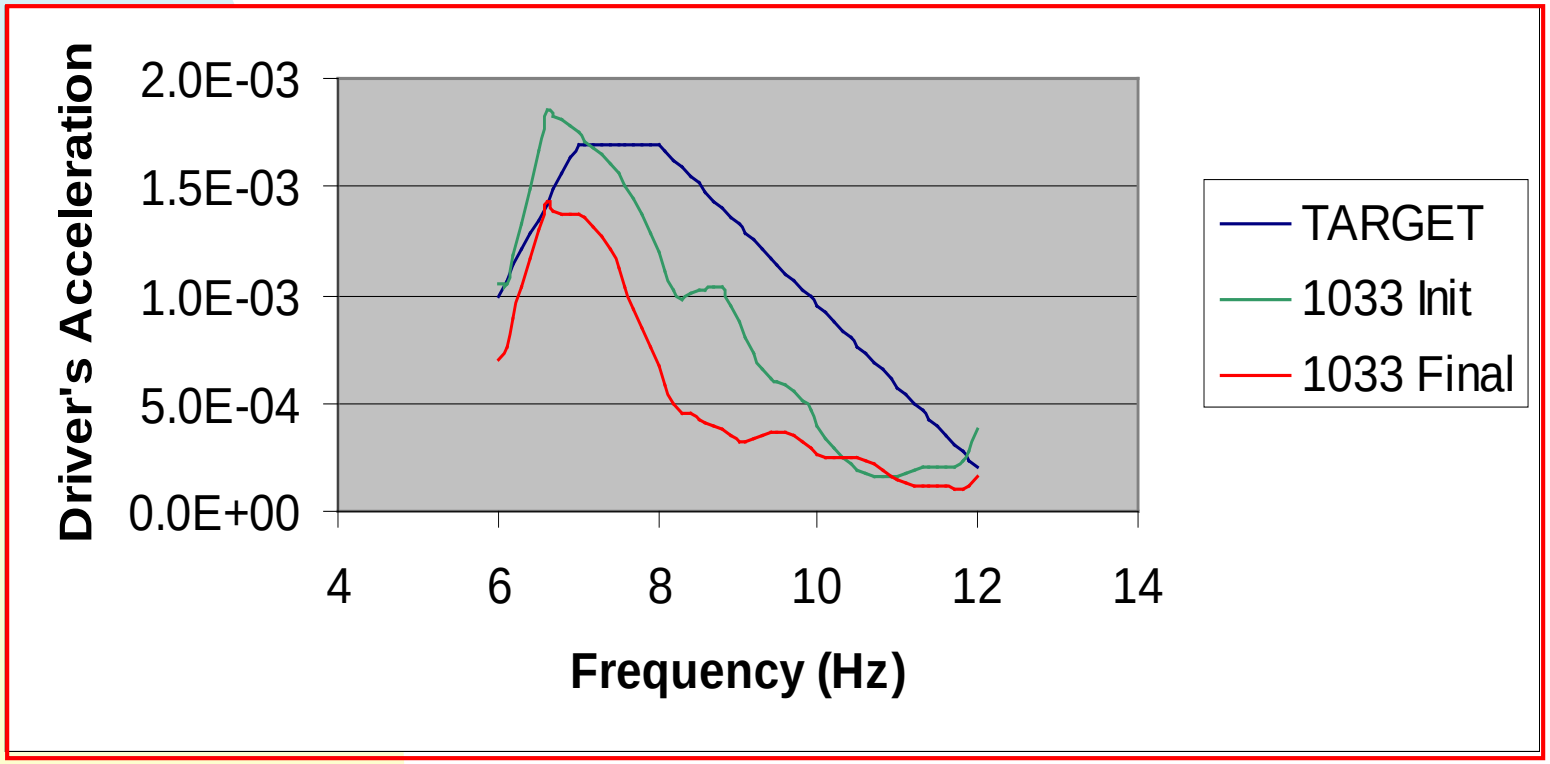
CASE A – DESIGN VARIABLES



PSDxxx Response (cont.)

EXAMPLE 2 (cont.):

- Case B: Limit is Placed on the PSD at the driver's seat as a function of Frequency



PSDxxx Response (cont.)

EXAMPLE 2 (cont.):

- CASE B – DESIGN OBJECTIVE:RMS Reduced from 0.071 to 0.058