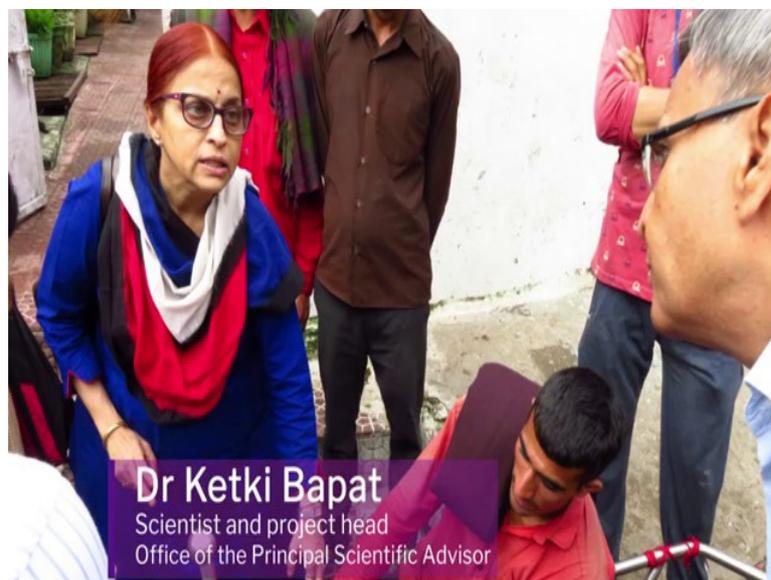


Innovation by Design
Dr. B. K. Chakravarthy
Dr. R Chidambaram
Department of Engineering Design
Indian Institute of Technology, Bombay

Module – 05
Start of section 6
Lecture - 34
A crucial step missed: Revelations from structural analysis

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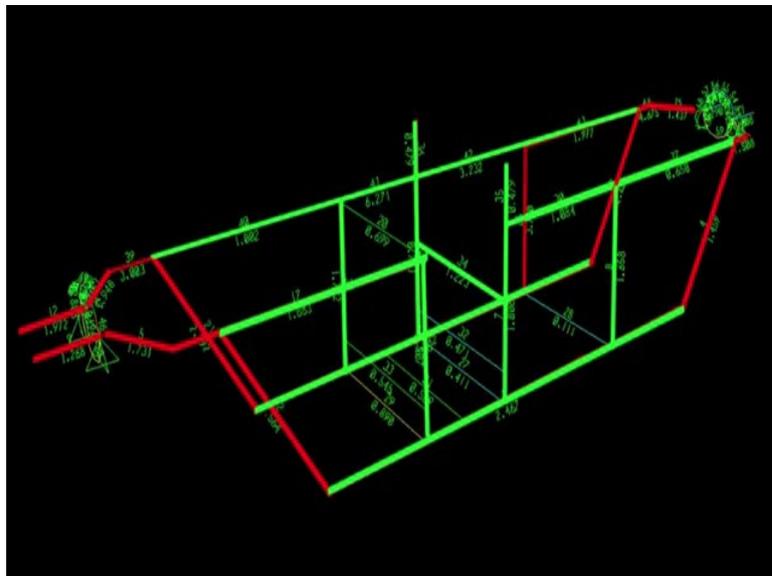
So, this is Mrs. Ketki Bapat is from the, you know, scientific advisors' office, she is the project in charge. She also went for trials she used to check up what the, you know palki is doing.

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We had, this is at IIT Bombay where we made multiple prototypes one after the other as you see. And then interestingly Ketki Bapat you know kept on telling me that Chakravarthy you must go for an FEM analysis.

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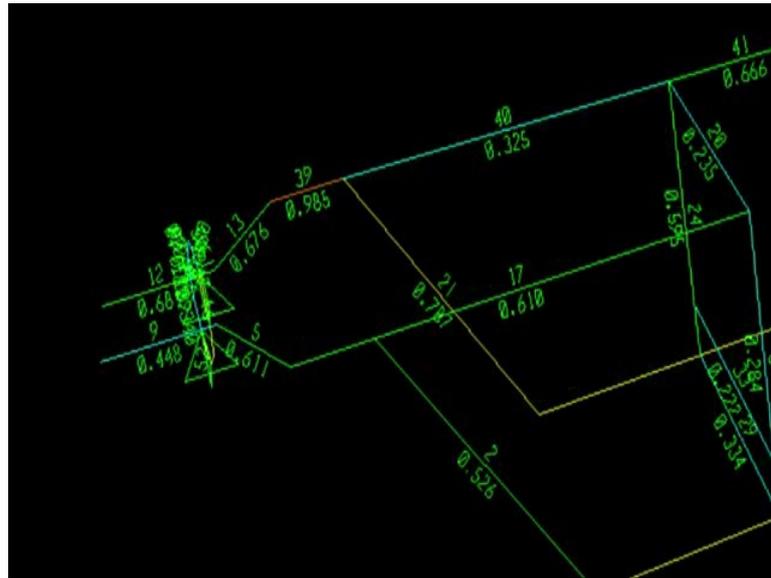


I was very naive and that is a very big mistake I did that we did not do any FEM analysis day 1. What does finite element analysis give you?

Student: Stress points?

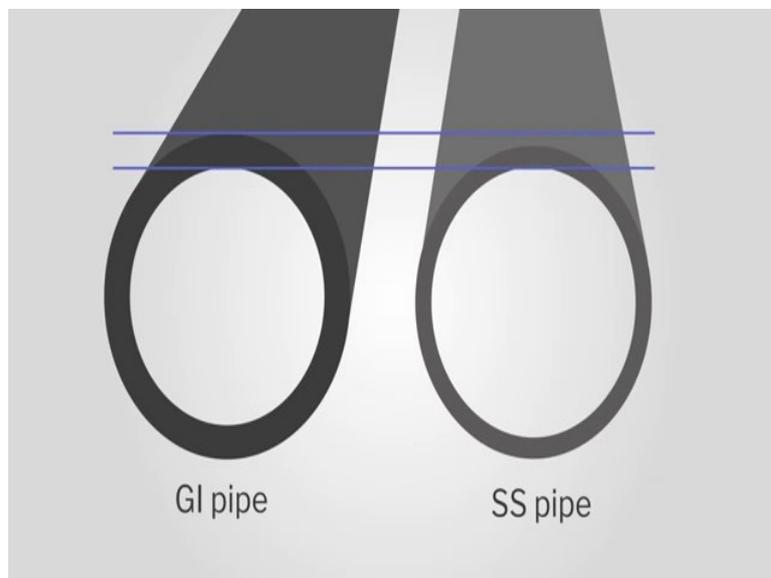
Stress points and what else can give you? Design cues to reduce stress and make the design more effective and more safe.

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So, when we did the analysis of the existing palki look at the red lines there were so many places there were stresses. Even the palki we designed, because we just copied the design we did not change anything and we reduced the thickness of the pipe.

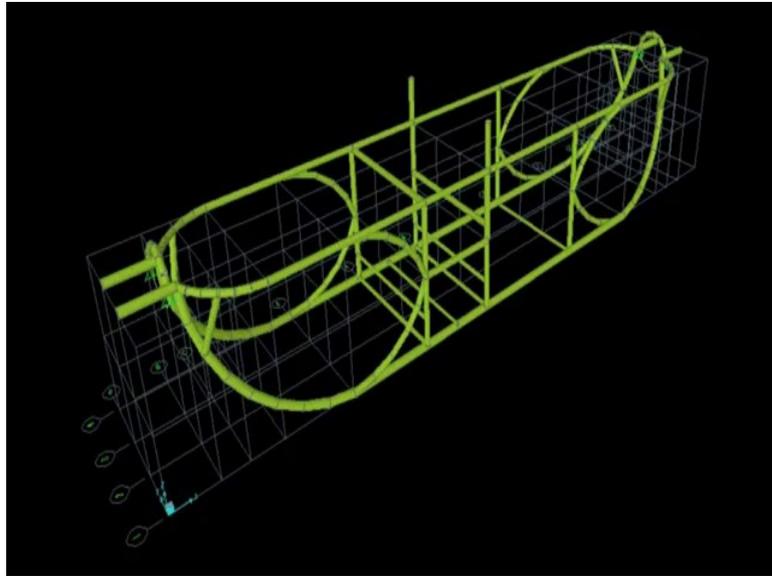
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We made it worse than their design by making it lightweight and making it thin sections. So, we went back to drawing board then we did the analysis we increased the diameter of the pipes, we increased the weight from 24 again to 30; 30 kilos still has a reduction of

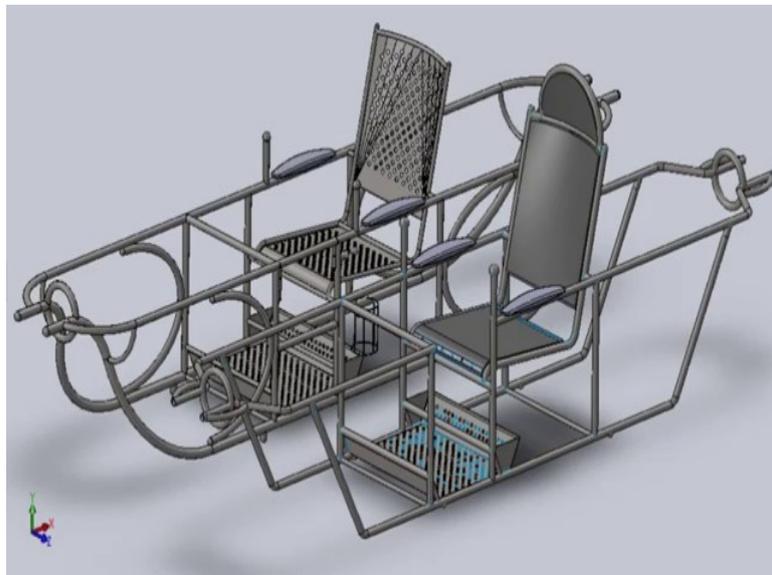
10 kilos in the design and we found out what would make the palki more you know stronger and more long lasting.

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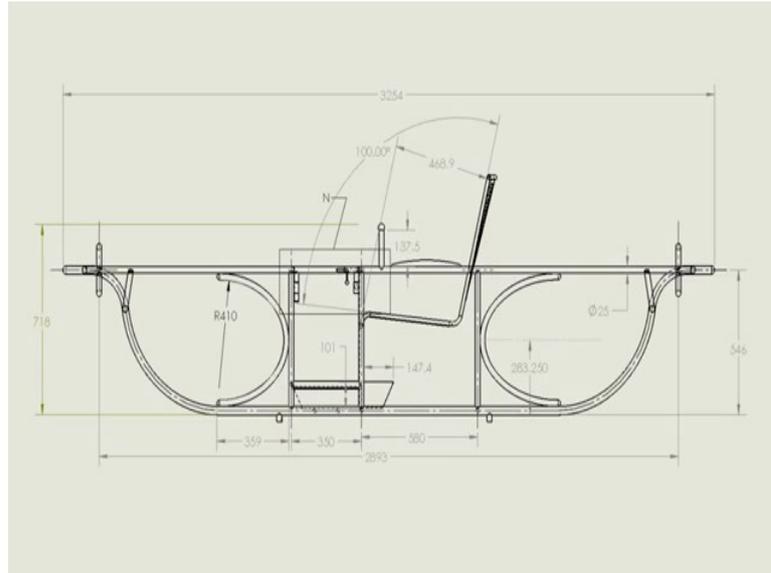
So, this is the final CAD solution.

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And you know we compared the old and new.

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We made the final design, did the engineering.

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And we fabricated this in a studio and we got all the best welding people from Andheri who has been you know real expert and build the whole prototype in the studio.

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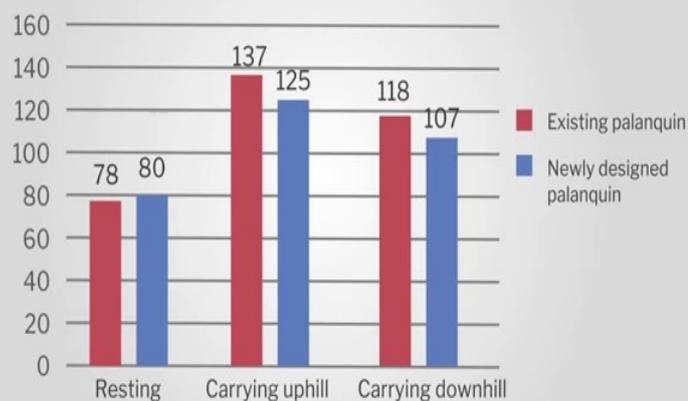
Comparison between traditional palki and modified palki

Description	Traditional palki	Modified palki
Material	GI pipe & mild steel	Stainless steel grade 304
Weight	45 kgs to 65 kgs	34 kgs
Longevity	Will start rusting at welding joints within 1 year	Never rusts
Load carrying capacity	FEA analysis shows failed when carrying 80-100 kgs	Approved for 150 kgs in FEA analysis
Aesthetic look	Crude	Modern and elegant
Handling space for porters	Normal	Spacious in comparison
Maintenance	Half yearly/yearly	No maintenance needed

We wanted to test this prototype again with the users, end users because now we made a lot of changes again to the grips we need to take the opinion of the porters. So, this time we actually brought the porters from Vaishno Devi here, but if you are noticing, all the grips we retained are similar only thing the angles are changed. So, they stayed with us for two three weeks, they gives a lot of inputs and you know finally, program review committee members the chairman and other people took a ride inside IIT on the palki its lightweight as well as you know you know extremely robust and the design you know was taken.

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Heart rate responses of the porters while carrying existing and newly designed palanquin with pilgrim on actual terrain condition- NITIE



And then finally, we found out thanks to NITIE again they did an analysis of the heartbeat, the rate of the porter, in this you get to know how much effort the porters are having and I think it's a very good move from what we see in these figures.

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With reduction of palki weight to 34 kgs

- Easy for the porters
- Durability and maintenance is good
- Comfortable seating for patrons
- Possibility of local manufacturing

There is a reduction to 34 kgs now hence its easy for the porters. Durability and maintenance is phenomenally good, there is a comfortable seating for the patrons who are coming in, there is a possibility of manufacture in local because its stainless steel and welding is pretty easy and effective, there are a lot of vendors in Katra we found who could actually manufacture for us. And there is enhanced safety due to ergonomics, engineering and design intervention as a collaborative project.

And then I thought we can also look at the occupational health of the palki bearer. So, that is why I got director of NITIE Dr Karuna Jain into it and now this has a wonderful product which has now been created and understand the palki bearers are very happy with it. And the occupational health aspects which give them problem in the shoulder, the back and the knee has also been substantially taken care.

Mera naam Mohammed Ashraf mein 2000 se yahan Katra VaishnoDevi mein kam kar raha hu. Toh humara jo palki purani wali palki thi 80 kg uska weight tha.

Jo palki hai ye bohot achi hai jo chalne me julam hai. step isme thek rehti hai aur chalne me bhi thek rehti hai. Usme jo pehle me Juan jo rehte hai chal chal ke unke ghutne fail

hoke khatam ho gaye mar gaye. Ye palki hum bhi chahte hai ki yeh nuksaan koi nahi pahuchaegi

Pehle ki jo palkia thi unko woh 3-4 saal me tut jatithi aur uska repair ka humko kharcha karna padta tha. Abhi ye palkia aayi usme repair ka koi kharcha nahi hai, yeh kam se kam 10 saal tak chalegi.

Ab jo ITI Bambai se aur shrine board ka shukarguzar hai jo ye 20-30/35 kilo weight ki palki aur yatra saheban ko baithne me achi lag rahi hai.

So, while all this was happening we requested one of our, you know manufacturing partners to manufacture 10 prototypes.

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And the most probably the launch will happen within a month of this palki.

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Module 5: The Check
Summing up

- The Check is the most valuable stage in design innovation. It gives a clear direction to the design innovation, without losing focus on the needs of the target user.

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Module 5: The Check
Summing up

- Every point in the checklist needs to be clearly met in the design process. It was for this reason that several rounds of prototypes of the palki were created.

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Module 5: The Check
Summing up

- Oversights at this stage of innovation can result in setbacks as the design advances. The delay in the structural analysis of the palki illustrates this. It was only after the insights from the structural analysis were integrated in the design that the final palki came through as a success.