Internship Report

Company: Rane Steering Systems Ltd, R&D Division

Duration: 4 weeks (26th May – 20th June)

Presented by – Mohnish Raja

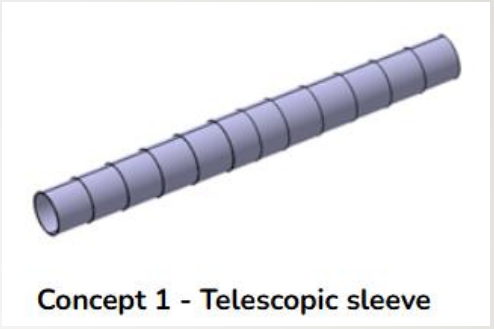
Date: 20/06/2025

Initial Plan (What I intended)

- Learn about Steering Column parts, their functions and working.
- Understand design phases, new product development, and structural/mechanical analysis.
- Discover innovations in design, patents, and learn about CAD/CAE tools.
- Participate in an application-oriented tasks and present learnings.

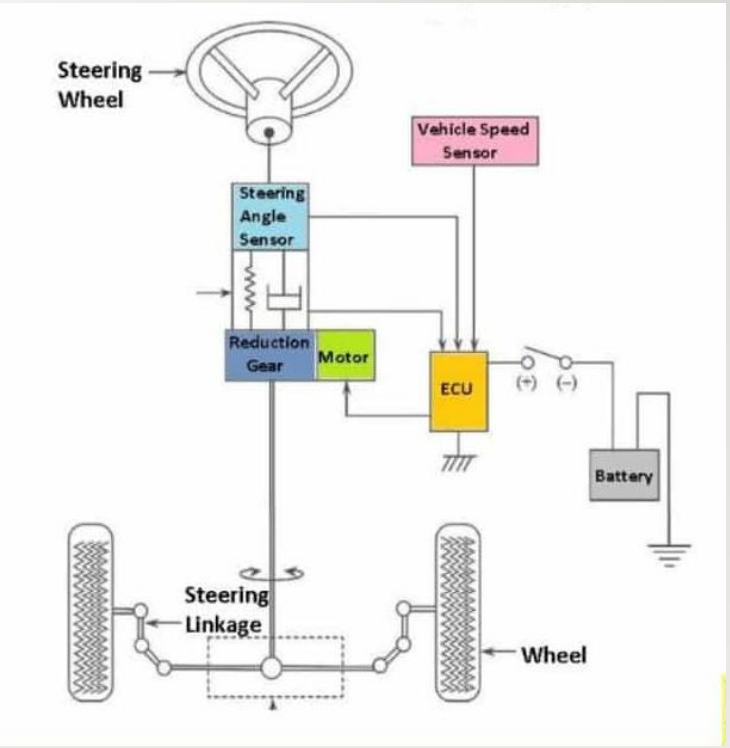
What I Actually Did

- Studied Steering Column design & performed design tasks (ex: Disc Spring Washer Design, Extension Spring Design for MSC).
- Proposed design ideas for Column Sleeve and learnt how to create a comparison matrix for different types of sleeves (Bellow – type, telescopic, etc.)
- Learnt the working of EPS through discussions with Senior Managers & Engineers. Studied few patents to understand the control loops in EPS.
- Observed CAE use cases (linear/non-linear) & created internal documents and presented learnings to the R&D team.



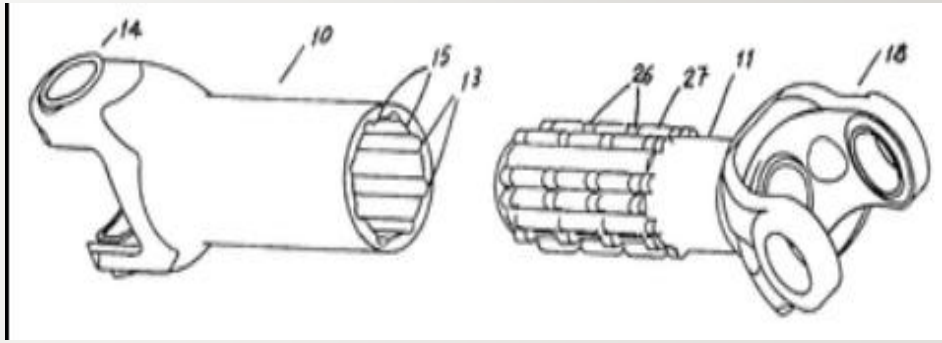
Concept 1 - Telescopic sleeve

Concept 2 - Bellow sleeve



What I Actually Did

- Visited the Testing Lab and observed MSC and EPS validations, gaining a clear understanding of test conditions and column performance.
- This experience offered valuable insight into how columns behave and perform under real-world use.
- Had an overview of how innovations are implemented in existing designs and how they are verified.
- Studied and created flowcharts in Product Development procedures like QSP (Quality System Procedure) charts.



Planned v/s Actual Comparison

Week	Planned Activities	Actual Activities
Week 1	Learn parts & working of steering columns	Understood parts & performed design tasks
Week 2	Design phases, new product dev, and structural analysis	Created a sleeve design comparison matrix, studied and created flowcharts of Product Development processes
Week 3	Innovations, CAE tools, patents	Test Lab visit, CAE use cases overview, EPS working overview
Week 4	Application-oriented tasks & presentation	Modification of previous design task(Extension Spring) & presentation.

Why the plan evolved

- The actual work was aligned with R&D priorities and mentors' guidance, making it more application-focused.
- A couple of tasks that were planned didn't come under the scope of the company, for example - Ergonomics.
- Previously unplanned visit to Test Lab gave hands on exposure where I observed how columns perform and are validated under different conditions.

Final Deliverables

- Design Iterations & Spec for:
    1. Disc Spring Washer for Lever of MSC
    2. Wave Washer for Lever of MSC
    3. Extension Spring for Tilt Mechanism in MSC
- Sleeve for Column Shaft:
    1. Design Ideas – Bellow Type & Telescopic
    2. Sleeve Comparison Matrix for 4 types of sleeves
- Contributed in QSP Process Flow Chart creation with the help of existing QAS Chart

Extension Spring Calculation

A	B	C	D	E	F	G	H	I	J
Extension Spring Spec									
S.No	Parameters	Iteration 1(Original)	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6	Iteration 7	Iteration 8
1	No. of active turns	9.333333333	7	7.777777778	9.333333333	7.368421053	7.777777778	8.235294118	8.75
2	Shear Modulus G (MPa)	78500	78500	78500	78500	78500	78500	78500	78500
3	Diameter of material d (mm)	1.5	2	1.8	1.5	1.9	1.8	1.7	1.6
4	Coil Outside diameter D_1 mm)	19	19	19	19	23	24	19	19
5	Coil Inner diameter D_2 (mm)	16	15	15.4	16	19.2	20.4	15.6	15.8
6	Coil mean Diameter D (mm)	17.5	17	17.2	17.5	21.1	22.2	17.3	17.4
7	Spring index C	11.66666667	8.5	9.555555556	11.66666667	11.10526316	12.33333333	10.17647059	10.875
8	Free Length H_f (mm)	35	35	35	35	35	35	35	35
9	Initial Tension N (Newton) - 15N given	3.821903741	17.06678362	10.93862336	5.095871655	9.02358338	6.566192549	8.602665208	6.672844071
10	Stress Correction Factor X	1.123026786	1.172352941	1.152022803	1.123026786	1.129597897	1.116041335	1.142164295	1.132501091
11	Spring Constant k (N/mm)	0.9931018326	4.565147858	2.602728208	0.9931018326	1.847448212	1.210473361	1.922020129	1.395095065
12	Deflection at Tilt Down(mm) - from CAD	15.81	15.81	15.81	15.81	15.81	15.81	15.81	15.81
13	Deflection at Nominal Posn.(mm) - from CAD	10.125	10.125	10.125	10.125	10.125	10.125	10.125	10.125
14	Deflection at Tilt Up(mm) - from CAD	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28
21	Spring force required at tilt down position P_req (N)	44.36	44.36	44.36	44.36	44.36	44.36	44.36	44.36
22	Spring force generated at Tilt Down P (N)	30.70093997	87.17498764	56.14913296	30.70093997	44.20815623	34.13758383	45.38713823	37.05645298
	Spring force generated at Nominal Posn. P (N)	13.8770598	63.28890569	37.29124647	15.15102771	27.72899652	18.82223533	28.06311901	20.79818161
	Spring force generated at Tilt Up P (N)	8.072379585	36.60561645	22.07830009	9.346347498	16.93066173	11.74701853	16.82891136	12.64385095
15	Max deflection (mm)	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
16	Max Torsional Stress T_max (MPa)	308.3835892	566.1423034	450.6587129	308.3835892	338.3060009	278.0691362	399.3181761	351.9597849
17	Safe Torsional Stress(MPa)	262.1260508	481.2209579	383.059906	262.1260508	287.5601008	236.3587658	339.4204497	299.1658171
18	Initial Torsional Stress T_i (MPa)	50.46428571	92.35294118	82.15116279	67.28571429	70.68720379	63.64864865	77.13872832	72.18390805
19	*Safe Deflection(mm)	13.9516268	12.87772571	12.80808707		12.70584752	12.6248275	12.76712317	12.72103878
20	Safe spring force(N)	17.67728988	75.85550557	44.27459288	#VALUE!	32.49697867	21.84820993	33.14133293	24.41990249
23	Winding Direction	Right	Right	Right	Right	Right	Right	Right	Right
24	No. of Endurance cycles	20000	20000	20000	20000	20000	20000	20000	20000
*Safe deflection - Deflection within which spring can be extended or compressed for infinite cycles									

Technical Learnings

- Understanding constraints in steering column design majorly through the performed Design tasks. Also learnt the dynamics of springs & washers.
- Role of CAE and Testing in design verification. Observed various methods and conditions in which Steering Columns are tested.
- Had insights on the Process Flow of developing a new product through the QSP & QAS flow charts.
- Understood the importance of checking on the feasibility of a product while designing it.

Soft Skills Developed

- Technical communication and structured reporting.
- Time management across varying tasks given.
- Learnt how to seek and apply feedback from mentors, managers and colleagues, who are on a busy schedule.
- Understanding multidisciplinary interactions within R&D.
- Proper documentation of work done and tasks performed.

Acknowledgements & Reflections

- Thanks to the R&D team and especially my mentors – Mr. Ezhumbarithi & Mr. Venkadeshwaran for their support and guidance throughout the Internship.
- Special Thanks to Mr. Ramnath for providing me this opportunity.

- Through this Internship, I developed a more realistic view of how theoretical knowledge applies in industry.

Thank You!