APPENDIX-A

QUESTIONNAIRE FOR PATIENT SATISFACTION SURVEY

PATIENT SATISFACTION SURVEY

Study Number 01
Date 09/01/2020

Patient Name: Mr. SANMUKHBHAI NATHUBHAI PATEL

Address: TADKESHVAR VILLAGE, MANDVI TALUKA, SURAT, GUJARAT, INDIA.

City SURAT State GUJARAT Pin code 394170

Phone (Home) – Phone (Work or other) M: 9638439618

Email Id: – AGE: 48 Y

Your answer to the following questions will be used to improve the quality of prosthetic devices and services.

Where is your pain located (also please draw on the diagram in the below figure)? : As Mentioned in Fig.

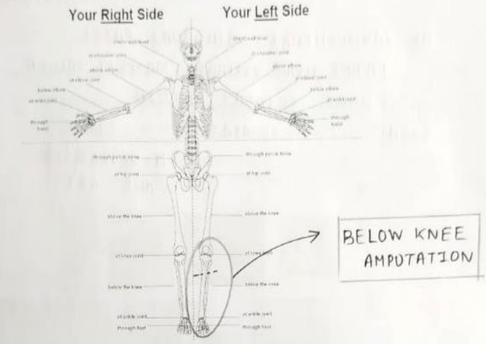
How long have you had your pain problem? It may develop after the Accident. (5 Years)

Briefly describe how your pain started: I had an accident before 5 years ago and because of that my lower leg amputated. In that time duration some problems like Infection, skin breakdown, Blood clots and feeling pain in amputated limb started

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Pain Location
Mark on the drawing below the exact spot where your pain is located.

Your Right Side Your Left Side



1) How easy was it to schedule an appointment?
☑ Very easy ☐ Difficult

2) Please rate the level of knowledge, care and attention you received from your provider.
☐ Excellent ☐ Good ☑ Satisfactory ☐ Poor

3) Did you discuss your goals and objectives related to your care with your provider?
☑ Yes ☐ No

4) Did you receive your device(s) when your provider indicated you would?
☐ Yes ☑ No

5) What is the Name of your Prosthetics device and approximately cost of it?
Jaipur Foot (Earlier) ; Now Foot of local Manufacturer

6) How satisfied are you with your device(s)?
☐ Satisfied ☐ Mostly satisfied ☐ Neutral ☐ Mostly dissatisfied ☑ Dissatisfied

7) Using the following scale, how comfortable is your socket?
0 to 10 scale with 0 being no pain and 10 being very painful
0 1 2 3 4 5 6 ✓ 7 8 9 10

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

8) Were the instructions regarding the use and care of your device useful?
☐ Very useful ☑ Somewhat useful ☐ Not useful ☐ I didn't get instructions

9) Were you instructed in the purpose and function of the device(s)?
☑ Yes ☐ No ☐ I don't remember

10) Were you instructed in the proper maintenance and/or cleaning of the device(s)?
☑ Yes ☐ No ☐ I don't remember

11) Were you instructed about the potential risks, benefits and precautions associated with the device(s)?
☑ Yes ☐ No ☐ I don't remember

12) Were you instructed on how to inspect your skin for signs of problems?
☑ Yes ☐ No ☐ I don't remember

13) Were you instructed on when and to whom you should report changes in your physical condition or general health?
☑ Yes ☐ No ☐ I don't remember

14) Please rate the training you (or your caregiver) received about the device(s):
☐ Excellent ☐ Very Good ☑ Good ☐ Fair ☐ Poor ☐ I received no training

15) How many days per week, on average, do you wear the prosthesis? Number of days: 07 days

16) Has the prosthesis made it uncomfortable to sit down? - Yes

17) Have you had difficulty feeling what type of surface you are standing/walking on?
- It is difficult to walk on slippery surface.

18) How important is it that the weight of your prosthesis feel right?
- Because of Heavy weight there is fitting and alignment Problem

19) In general, what was the major reason why you stopped using each type of prosthesis?

- ✓ It hurts to wear the prosthesis.
- ✓ It is tireless wearing the prosthesis.
- ✓ I move about too slowly when I am wearing the prosthesis.
- ☐ My hands are not free when I am wearing the prosthesis.
- ☐ I feel that my life is simpler without the prosthesis.
- ☐ I do not like the prosthesis.
- ☐ I have experienced other difficulties that make it hard to wear the prosthesis.
- ✓ It is too heavy.
- ✓ It is uncomfortable.
- ✓ It is too long to put on and take off.
- ☐ I grew out of it (or weight changed)
- ✓ Didn't fit well
- ✓ Difficulty handling
- ☐ Could not fully bend elbow
- ☐ Too noisy
- ☐ Not functional – why:
- ☐ Battery recharging
- ☐ Other reason (please specify):

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

20) WHAT CHANGES DO YOU NEED TO MAKE TO YOUR DEVICE?

→ Prosthesis should enable the person daily activities such as walking and dressing properly.
→ It should be lightweight.
→ It should be affordable.

Patient Photograph

THANK YOU VERY MUCH FOR SPARING YOUR PRECIOUS TIME FOR ME.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Figure 1: Patient feedback form 1

PATIENT SATISFACTION SURVEY

Study Number 02
Date 09|01|2020

Patient Name:
Mr. PARMAR GANPATBHAI LIBABHAI

Address: PIPALIYA, CHHAPARWAD POST OFFICE, SINGVAD, DAHOD, GUJARAT, INDIA

City DAHOD State GUJARAT Pin code 389130

Phone (Home) - Phone (Work or other) M: 91-9687912968

Email Id: - AGE: 35 Years

Your answer to the following questions will be used to improve the quality of prosthetic devices and services.

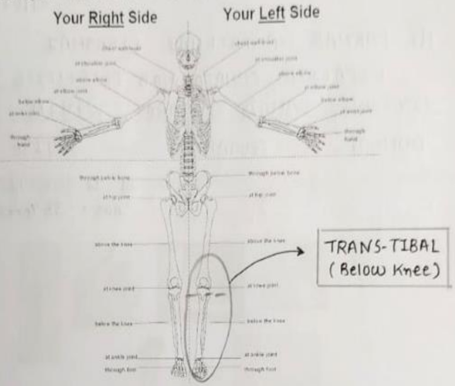
Where is your pain located (also please draw on the diagram in the below figure)? As Mentioned in Figure

How long have you had your pain problem? PAIN HAS STARTED AFTER THE ACCIDENT (4 YEARS)

Briefly describe how your pain started: 4 years ago I had an accident that resulted in my lower leg being amputated. Some problems like skin infection, and swelling of the remaining limb started.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Pain Location
Mark on the drawing below the exact spot where your pain is located.



1) How easy was it to schedule an appointment?
☑ Very easy ☐ Difficult

2) Please rate the level of knowledge, care and attention you received from your provider.
☐ Excellent ☐ Good ☑ Satisfactory ☐ Poor

3) Did you discuss your goals and objectives related to your care with your provider?
☑ Yes ☐ No

4) Did you receive your device(s) when your provider indicated you would?
☐ Yes ☑ No

5) What is the Name of your Prosthetics device and approximately cost of it?
Foot prosthetic leg

6) How satisfied are you with your device(s)?
☐ Satisfied ☐ Mostly satisfied ☑ Neutral ☐ Mostly dissatisfied ☐ Dissatisfied

7) Using the following scale, how comfortable is your socket?
0 to 10 scale with 0 being no pain and 10 being very painful
0 1 2 3 4 5 6 ✓7 8 9 10

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

8) Were the instructions regarding the use and care of your device useful?
☐ Very useful ☑ Somewhat useful ☐ Not useful ☐ I didn't get instructions

9) Were you instructed in the purpose and function of the device(s)?
☑ Yes ☐ No ☐ I don't remember

10) Were you instructed in the proper maintenance and/or cleaning of the device(s)?
☑ Yes ☐ No ☐ I don't remember

11) Were you instructed about the potential risks, benefits and precautions associated with the device(s)?
☑ Yes ☐ No ☐ I don't remember

12) Were you instructed on how to inspect your skin for signs of problems?
☑ Yes ☐ No ☐ I don't remember

13) Were you instructed on when and to whom you should report changes in your physical condition or general health?
☑ Yes ☐ No ☐ I don't remember

14) Please rate the training you (or your caregiver) received about the device(s):
☐ Excellent ☐ Very Good ☐ Good ☑ Fair ☐ Poor ☐ I received no training

15) How many days per week, on average, do you wear the prosthesis? Number of days: 06 Days

16) Has the prosthesis made it uncomfortable to sit down? - NO

17) Have you had difficulty feeling what type of surface you are standing/walking on?
- It is difficult to walk on uneven terrain.

18) How important is it that the weight of your prosthesis feel right?
- Because of heavy weight not able to walk properly.

19) In general, what was the major reason why you stopped using each type of prosthesis?
- ✓ It hurts to wear the prosthesis.
- ✓ It is tireless wearing the prosthesis.
- ✓ I move about too slowly when I am wearing the prosthesis.
- ☐ My hands are not free when I am wearing the prosthesis.
- ✓ I feel that my life is simpler without the prosthesis.
- ☐ I do not like the prosthesis.
- ✓ I have experienced other difficulties that make it hard to wear the prosthesis.
- ✓ It is too heavy.
- ✓ It is uncomfortable.
- ✓ It is too long to put on and take off.
- ☐ I grew out of it (or weight changed)
- ✓ Didn't fit well
- ✓ Difficulty handling
- ✓ Could not fully bend elbow
- ☐ Too noisy
- ☐ Not functional —why:
- ☐ Battery recharging
- ☐ Other reason (please specify):

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

20) WHAT CHANGES DO YOU NEED TO MAKE TO YOUR DEVICE?

→ Prosthesis should be light weight, water proof, and flexible.
→ It can be used for all occasions and activities.
→ Prosthetic can be worn with a variety of shoes.

Patient Photograph

THANK YOU VERY MUCH FOR SPARING YOUR PRECIOUS TIME FOR ME.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Figure 2: Patient feedback form 2

PATIENT SATISFACTION SURVEY

Study Number 03
Date 09/01/2020

Patient Name: Mr. AFTAB SAIKH

Address: SANTRAMPUR, MAHISAGAR, GUJARAT, INDIA

City MAHISAGAR State GUJARAT Pin code 389260

Phone (Home) – Phone (Work or other) M: 91-9510040362

Email Id: – AGE: 28 Years

Your answer to the following questions will be used to improve the quality of prosthetic devices and services.

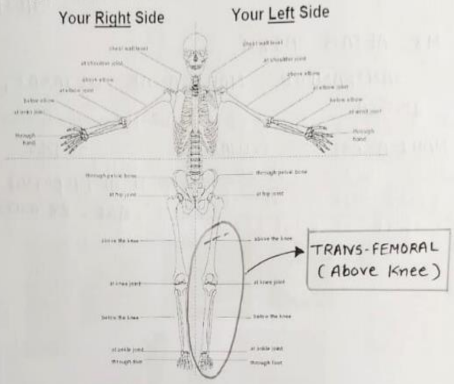
Where is your pain located (also please draw on the diagram in the below figure)? As mentioned in Figure

How long have you had your pain problem? It may develop after the accident (1.5 Years)

Briefly describe how your pain started: My leg was cut in bus accident before 1.5 Years ago and because of that above knee amputation occurs.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Pain Location
Mark on the drawing below the exact spot where your pain is located.



1) How easy was it to schedule an appointment?
☑ Very easy ☐ Difficult
2) Please rate the level of knowledge, care and attention you received from your provider.
☐ Excellent ☐ Good ☐ Satisfactory ☑ Poor
3) Did you discuss your goals and objectives related to your care with your provider?
☐ Yes ☑ No
4) Did you receive your device(s) when your provider indicated you would?
☐ Yes ☑ No
5) What is the Name of your Prosthetics device and approximately cost of it?
Knee Disarticulation Prosthetics
6) How satisfied are you with your device(s)?
☐ Satisfied ☐ Mostly satisfied ☐ Neutral ☐ Mostly dissatisfied ☑ Dissatisfied
7) Using the following scale, how comfortable is your socket?
0 to 10 scale with 0 being no pain and 10 being very painful
0 1 2 3 4 5 6 7 ✓8 9 10

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

8) Were the instructions regarding the use and care of your device useful?
☐ Very useful ☐ Somewhat useful ☐ Not useful ☑ I didn't get instructions
9) Were you instructed in the purpose and function of the device(s)?
☑ Yes ☐ No ☐ I don't remember
10) Were you instructed in the proper maintenance and/or cleaning of the device(s)?
☐ Yes ☑ No ☐ I don't remember
11) Were you instructed about the potential risks, benefits and precautions associated with the device(s)?
☑ Yes ☐ No ☐ I don't remember
12) Were you instructed on how to inspect your skin for signs of problems?
☑ Yes ☐ No ☐ I don't remember
13) Were you instructed on when and to whom you should report changes in your physical condition or general health?
☐ Yes ☐ No ☑ I don't remember
14) Please rate the training you (or your caregiver) received about the device(s):
☐ Excellent ☐ Very Good ☐ Good ☑ Fair ☐ Poor ☐ I received no training
15) How many days per week, on average, do you wear the prosthesis? Number of days: 07 days
16) Has the prosthesis made it uncomfortable to sit down? – Yes.
17) Have you had difficulty feeling what type of surface you are standing/walking on?
- It is difficult to walk on uneven and climbing stairs.
18) How important is it that the weight of your prosthesis feel right?
- Fitting and Alignment Problem
19) In general, what was the major reason why you stopped using each type of prosthesis?
✓ It hurts to wear the prosthesis.
✓ It is tireless wearing the prosthesis.
✓ I move about too slowly when I am wearing the prosthesis.
✓ My hands are not free when I am wearing the prosthesis.
I feel that my life is simpler without the prosthesis.
✓ I do not like the prosthesis.
✓ I have experienced other difficulties that make it hard to wear the prosthesis.
✓ It is too heavy.
✓ It is uncomfortable.
✓ It is too long to put on and take off.
I grew out of it (or weight changed)
✓ Didn't fit well

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

✓ Difficulty handling
✓ Could not fully bend elbow
Too noisy
Not functional — why:
Battery recharging
Other reason (please specify):

20) WHAT CHANGES DO YOU NEED TO MAKE TO YOUR DEVICE?

→ Prosthetic should be lightweight and aesthetically Pleasing.
→ Prosthetic can be custom fitted and durable.
→ Foot Mechanism should be in such a way that it can bend properly.

Patient Photograph

THANK YOU VERY MUCH FOR SPARING YOUR PRECIOUS TIME FOR ME.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Figure 3: Patient feedback form 3

PATIENT SATISFACTION SURVEY

Study Number 04
Date 09/01/2020

Patient Name: Mr. DASRATHBHAI BURIYA

Address: SARJIMI, SINGOD, DAHOD, GUJARAT, INDIA

City SINGOD State GUJARAT Pin code 394335

Phone (Home) – Phone (Work or other) M: 7359878804

Email Id: – AGE: 51 Years

Your answer to the following questions will be used to improve the quality of prosthetic devices and services.

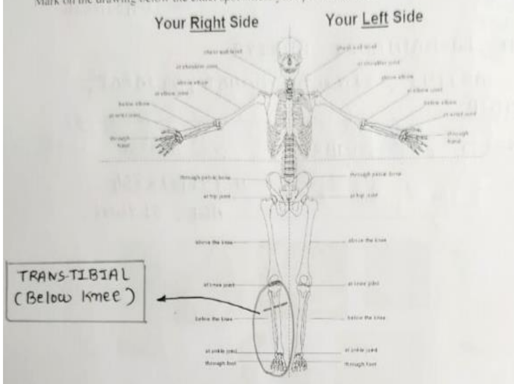
Where is your pain located (also please draw on the diagram in the below figure)? As mentioned in figure

How long have you had your pain problem? Pain has started after the accident. (2 Years)

Briefly describe how your pain started: I had an accident before 2 years ago and because of that below knee ampautation occurs

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Pain Location
Mark on the drawing below the exact spot where your pain is located.



1) How easy was it to schedule an appointment?
☑ Very easy ☐ Difficult

2) Please rate the level of knowledge, care and attention you received from your provider.
☐ Excellent ☐ Good ☑ Satisfactory ☐ Poor

3) Did you discuss your goals and objectives related to your care with your provider?
☑ Yes ☐ No

4) Did you receive your device(s) when your provider indicated you would?
☑ Yes ☐ No

5) What is the Name of your Prosthetics device and approximately cost of it?
Steel below knee Artificial limb

6) How satisfied are you with your device(s)?
☐ Satisfied ☐ Mostly satisfied ☐ Neutral ☐ Mostly dissatisfied ☑ Dissatisfied

7) Using the following scale, how comfortable is your socket?
0 to 10 scale with 0 being no pain and 10 being very painful

0 1 2 3 4 5 (6) 7 8 9 10

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

8) Were the instructions regarding the use and care of your device useful?
☐ Very useful ☑ Somewhat useful ☐ Not useful ☐ I didn't get instructions

9) Were you instructed in the purpose and function of the device(s)?
☑ Yes ☐ No ☐ I don't remember

10) Were you instructed in the proper maintenance and/or cleaning of the device(s)?
☐ Yes ☐ No ☑ I don't remember

11) Were you instructed about the potential risks, benefits and precautions associated with the device(s)?
☑ Yes ☐ No ☐ I don't remember

12) Were you instructed on how to inspect your skin for signs of problems?
☑ Yes ☐ No ☐ I don't remember

13) Were you instructed on when and to whom you should report changes in your physical condition or general health?
☑ Yes ☐ No ☐ I don't remember

14) Please rate the training you (or your caregiver) received about the device(s):
☐ Excellent ☐ Very Good ☐ Good ☑ Fair ☐ Poor ☐ I received no training

15) How many days per week, on average, do you wear the prosthesis? Number of days: 06 days

16) Has the prosthesis made it uncomfortable to sit down? – Yes

17) Have you had difficulty feeling what type of surface you are standing/walking on?
– wet surface and climbing a staircase

18) How important is it that the weight of your prosthesis feel right?
– The weight of prosthesis device should be light.

19) In general, what was the major reason why you stopped using each type of prosthesis?
- ✓ It hurts to wear the prosthesis.
- ☐ It is tireless wearing the prosthesis.
- ☐ I move about too slowly when I am wearing the prosthesis.
- ☐ My hands are not free when I am wearing the prosthesis.
- ☐ I feel that my life is simpler without the prosthesis.
- ✓ I do not like the prosthesis.
- ✓ I have experienced other difficulties that make it hard to wear the prosthesis.
- ✓ It is too heavy.
- ✓ It is uncomfortable.
- ☐ It is too long to put on and take off.
- ☐ I grew out of it (or weight changed)
- ✓ Didn't fit well
- ✓ Difficulty handling
- ☐ Could not fully bend elbow
- ☐ Too noisy
- ☐ Not functional — why: ______
- ☐ Battery recharging
- ☐ Other reason (please specify): ______

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

20) WHAT CHANGES DO YOU NEED TO MAKE TO YOUR DEVICE?

- Shoes are the biggest inconvenience for the Patient. So making something that can fit into a variety of shoes and getting out of those Shoes easily would be Ideal.
- There should be a devices that can work in farming.

Patient Photograph

THANK YOU VERY MUCH FOR SPARING YOUR PRECIOUS TIME FOR ME.

Prosthesis Evaluation Questionnaire by Mr. Piyush Patel (Ph.D. Scholar)
MECHANICAL ENGINEERING DEPARTMENT
M.S. UNIVERSITY, BARODA

Figure 4: Patient feedback form 4

APPENDIX-B

CLINICAL PERMISSION

MECHANICAL ENGINEERING DEPARTMENT
FACULTY OF TECHNOLOGY AND ENGINEERING
The Maharaja Sayajirao University of Baroda
Post Box No. 51, KALABHAVAN
VADODARA-390 001 (India).

To,
Dr. Khyati Vansadavala,
Prosthetist & orthotist,
Evolution Healthcare
Pvt. Ltd, Surat.

Subject: No Objection for Patient clinical trial/survey

Mr. Piyushbhai Thakorbhai Patel, Ph.D. Scholar in Faculty of Technology & Engineering, Mechanical engineering (The Maharaja Sayajirao University of Baroda). Our Institute has no objection for conducting clinical trial for his purpose of study to design a Prosthetics / Orthotics element which is light in weight, low cost, precisely manufactured and perfectly assemble to perform the intended function.

RESEARCH SUPERVISOR

Dr. Piyush P Gohil

Associate Professor,
Mechanical Engineering Department
Faculty of Technology and Engineering,
Maharaja Sayajirao University of
Baroda, Gujarat, India

Khyati

EVOLUTION HEALTHCARE PVT. LTD. SURAT

Faculty of Technology and Engineering
The Maharaja Sayajirao University of Baroda

INSTITUTIONAL ETHICS COMMITTEE

Date: 23/10/2021

To
Dr. Khyati Vansadavala,
Prosthetist & orthotist,
RCI No: A51452
Evolution Healthcare
Pvt. Ltd, Surat.

Dear Dr. Khyati Vansadavala

TITLE OF STUDY
Investigations on Prosthetics / Orthotics elements developed from polymers and its composites

RESEARCHER NAME
Name : Mr. Piyush T Patel
Designation : Ph.D. Scholar
Department : Mechanical Engineering Department
Address : Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, 390001, Gujarat, India
Phone : +91-9727139227
E-mail : piyush21659@gmail.com

RESEARCH SUPERVISOR
Name : Dr. Piyush P Gohil
Designation : Associate Professor
Department : Mechanical Engineering Department
Address : Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, 390001, Gujarat, India
Phone : +91-9879016723
E-mail : piyush.p.gohil-med@msubaroda.ac.in /push4679@yahoo.com

PURPOSE OF STUDY
The purpose of this study is to design a Prosthetics / Orthotics element in such a way that it can fully satisfied the main objectives. The objective is to design analysis and testing of components which is light in weight, low cost, precisely manufactured and perfectly assemble to perform the intended function.

Page 1 of 2

Faculty of Technology and Engineering
The Maharaja Sayajirao University of Baroda

The Prosthetics have to be changed and adjusted periodically as the human body changes over time due to growth or change in body weight which will mean that they may be unable to use their prosthesis for periods of time. This constant need for **change or adjustment** may become costly if the material used is expensive. The different methods will be proposed in order to overcome the difficulties faced by the previous researchers and introduce a new way of techniques. Therefore, the study proposes a new material which is more cost efficient and yet maintaining the features required in Medical field.

BENEFITS
You will also be informed of any new information discovered during the course of this study that might influence your health, welfare, or willingness to be in this study.

CONFIDENTIALITY
Information produced by this study will be stored in the investigator's file and identified by a code number only. The code key connecting your name to specific information about you will be kept in a separate, secure location. Information contained in your records may not be given to anyone unaffiliated with the study in a form that could identify you without your written consent, except as required by law.
In addition, if photographs, audiotapes or videotapes were taken during the study that could identify you, then you must give special written permission for their use. In that case, you will be given the opportunity to view or listen, as applicable, to the photographs, audiotapes or videotapes before you give your permission for their use if you so request.

CONTACT INFORMATION
If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page.

CONSENT
I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Doctor Name and sign Dr. Khyati Vansadavala Khyati

Patient name and sign Mr. Nikunj Maiskar NM

Ph.D. Scholar name & sign Piyush T. Patel Piyush

Research Supervisor name & sign Dr. Piyush. P. Gohil

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APPENDIX-C

PROSTHETIC FOOT VARIOUS CONFIGURATION MODELS ANALYSIS DATA

All phase analysis for Prosthetic foot Model 2

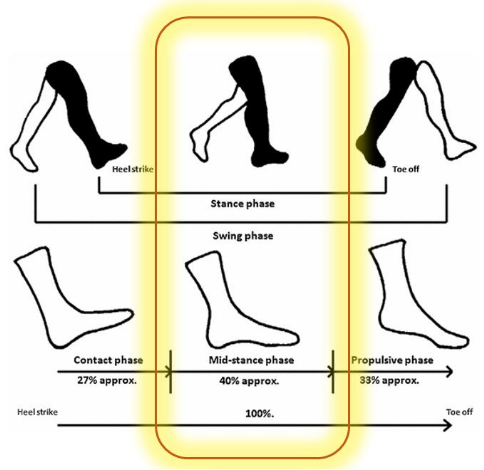

Figure 1: Prosthetic foot Model 2 in “Mid-stance” situation

Table 1: Midstance analysis on prosthetic foot model 2

Sr no.	Materials	Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	**ABS**	446.56	0.09735	8.9925	0.002324
2	**ABS+PC PLASTIC**	443.01	0.09693	8.9863	0.002218
3	**ACETAL RESIN**	422.71	0.09587	8.9686	0.001946
4	**CFRC**	1078	0.07392	22.691	0.001593
5	**NYLON 6/6**	335.28	0.10268	9.0049	0.003685
6	**PEEK**	504.95	0.09409	8.8455	0.001478
7	**PET**	433.79	0.0958	8.9871	0.001933
8	**PLA**	489.83	0.09468	8.9266	0.00164
9	**UHMW-PE**	1363	0.090459	18.284	0.0024725

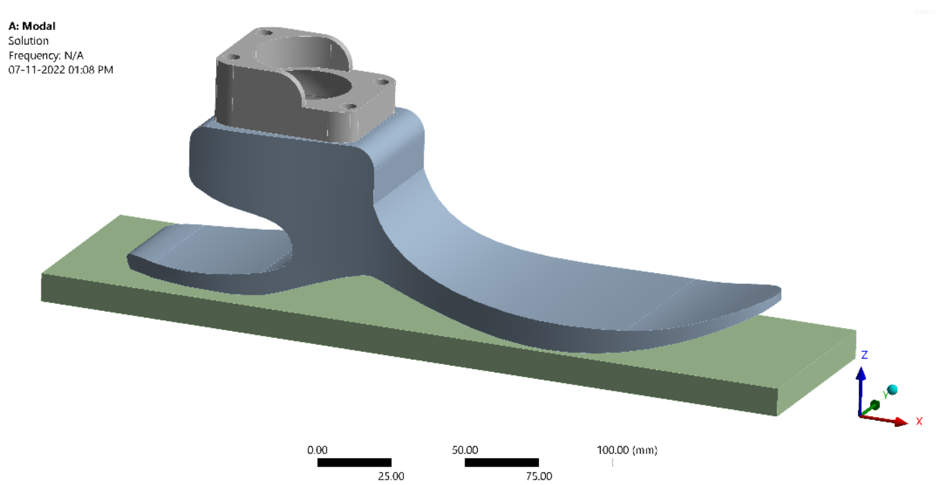

Figure 2: Prosthetic foot Model 2 geometry

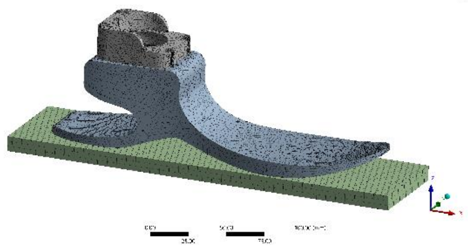

Figure 3: Mesh model

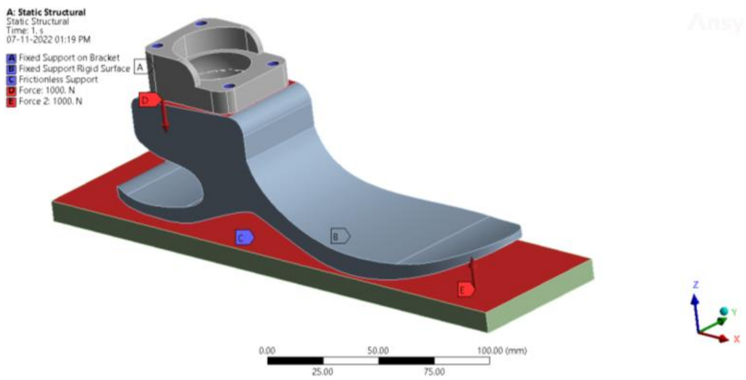

Figure 4: Static structural simulation

A) ABS

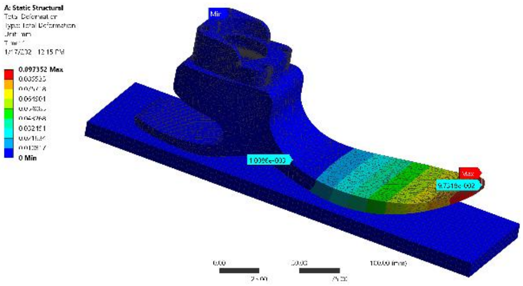

Figure 5: Total deformation (mm)

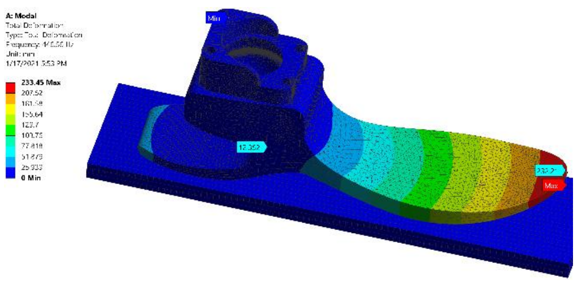

Figure 6: Total deformation (Hz)

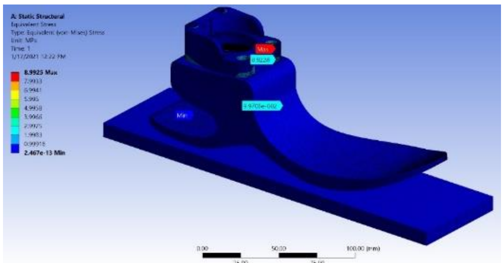

Figure 7: Equivalent Stress

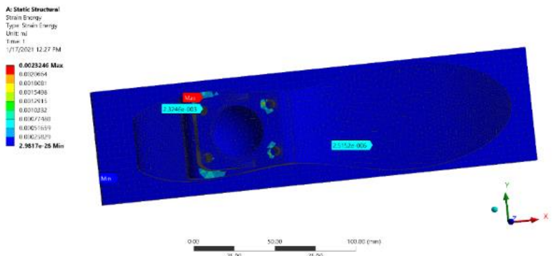

Figure 8: Strain Energy

B) ABS+ PC Plastic

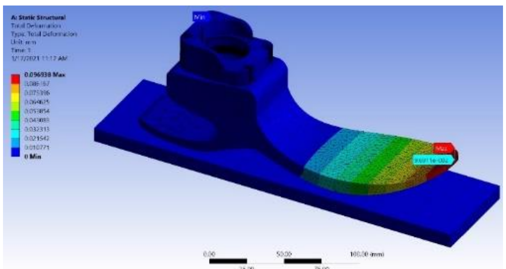

Figure 9: Total deformation (mm)

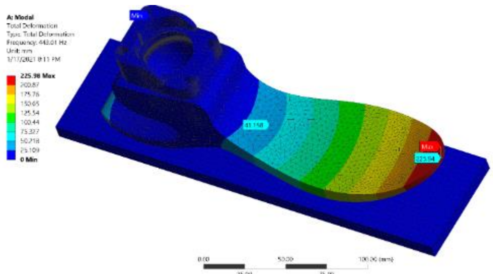

Figure 10: Total deformation (Hz)

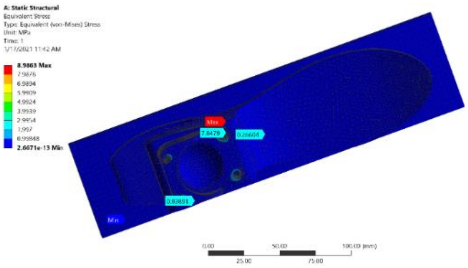

Figure 11: Equivalent Stress

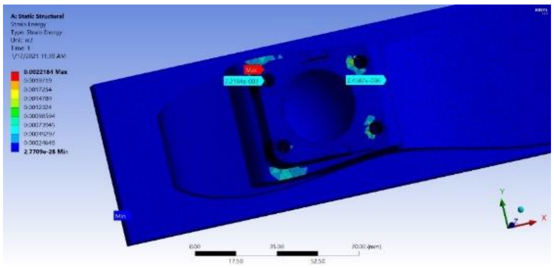

Figure 12: Strain Energy

C) ACETAL RESIN

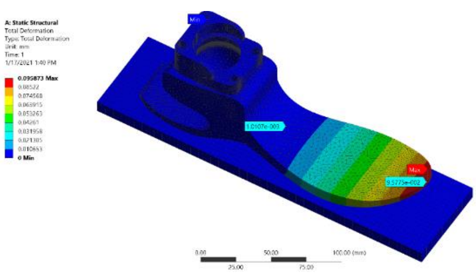

Figure 13: Total deformation (mm)

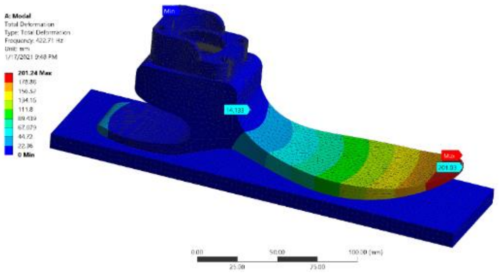

Figure 14: Total deformation (Hz)

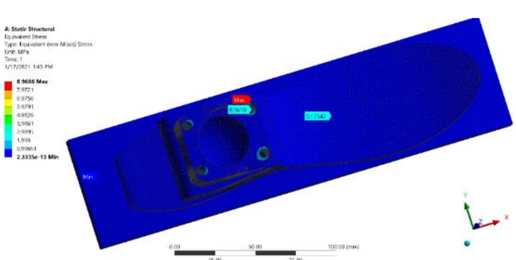

Figure 15: Equivalent Stress

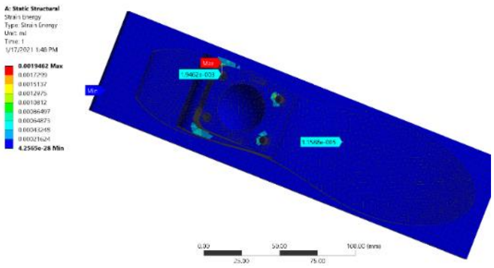

Figure 16: Strain Energy

D) CFRC

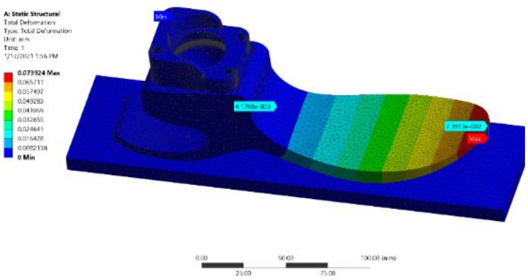

Figure 17: Total deformation (mm)

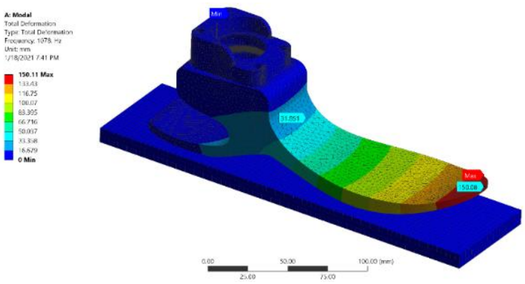

Figure 18: Total deformation (Hz)

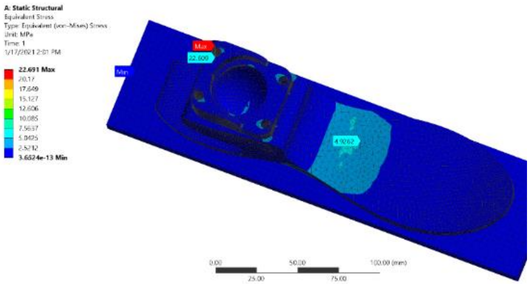

Figure 19: Equivalent Stress

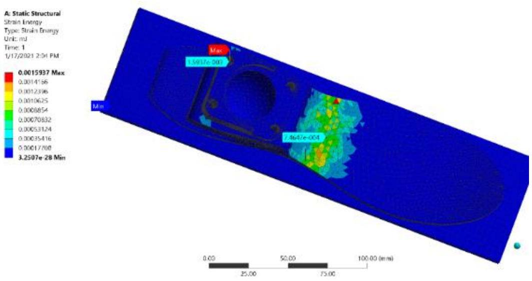

Figure 20: Strain Energy

E) NYLON 6/6

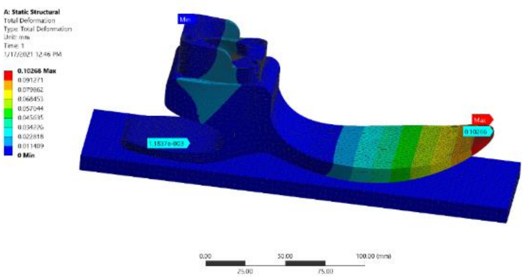
Figure 21: Total deformation (mm)

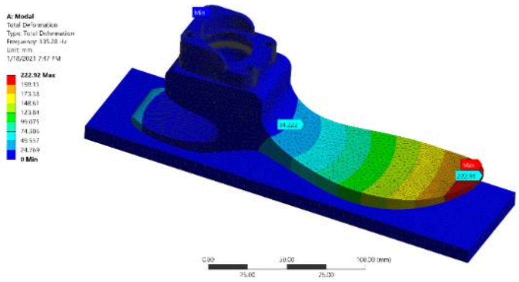
Figure 22: Total deformation (Hz)

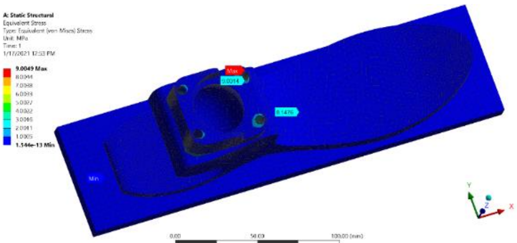
Figure 23: Equivalent Stress

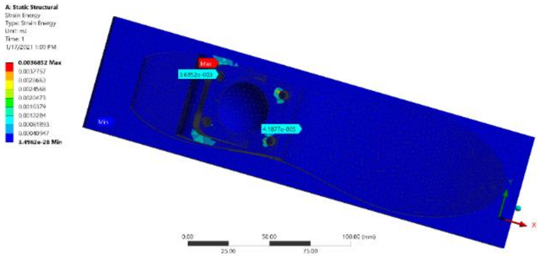
Figure 24: Strain Energy

F) PEEK

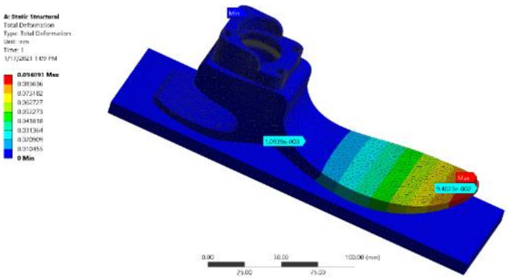
Figure 25: Total deformation (mm)

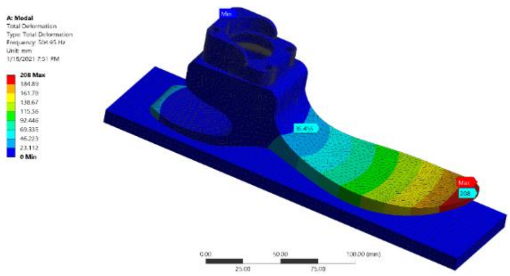
Figure 26: Total deformation (Hz)

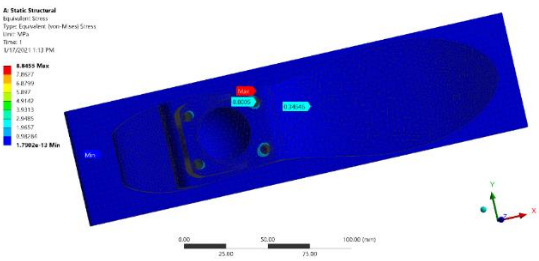
Figure 27: Equivalent Stress

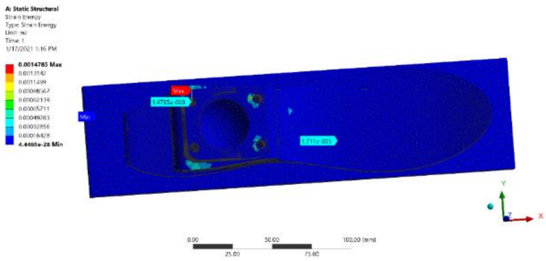
Figure 28: Strain Energy

G) PET

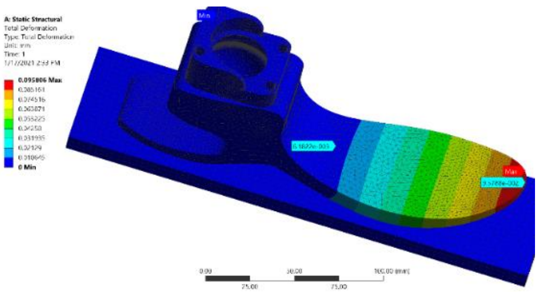
Figure 29: Total deformation (mm)

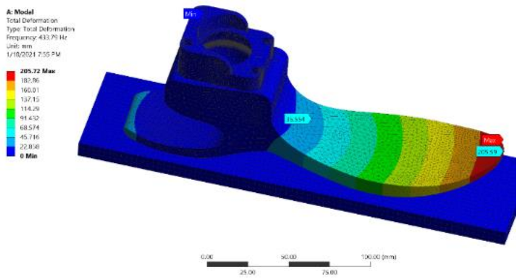
Figure 30: Total deformation (Hz)

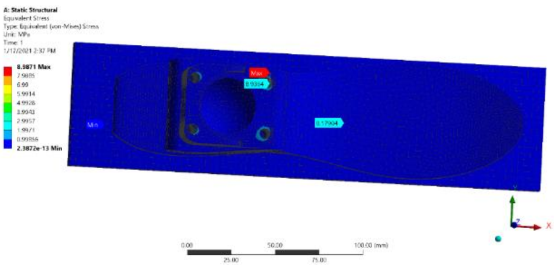

Figure 31: Equivalent Stress

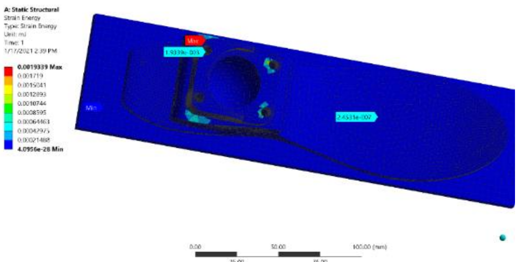

Figure 32: Strain Energy

H) PLA

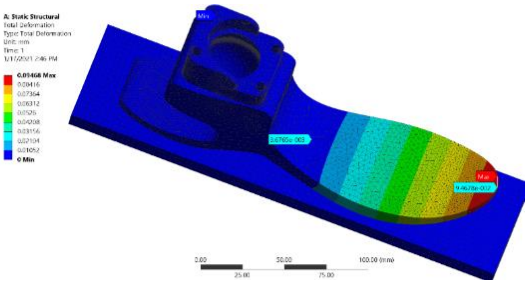

Figure 33: Total deformation (mm)

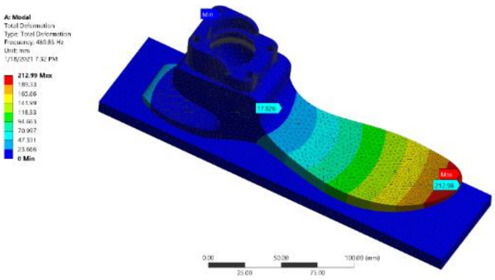

Figure 34: Total deformation (Hz)

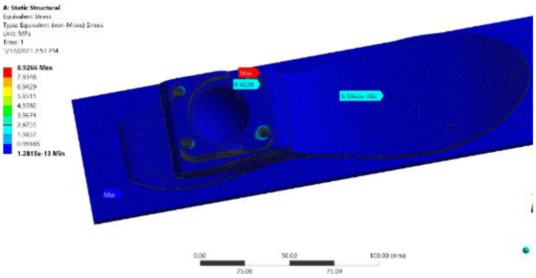

Figure 35: Equivalent Stress

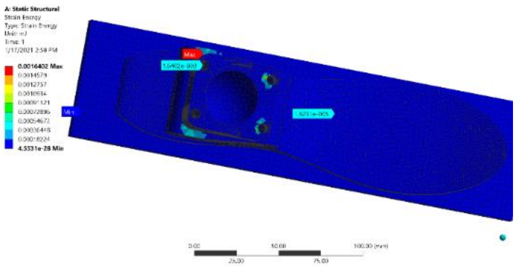

Figure 36: Strain Energy

I) UHMW-PE

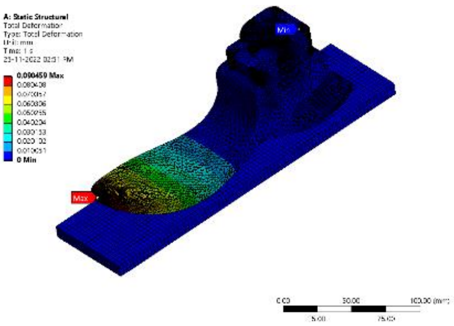

Figure 37: Total deformation (mm)

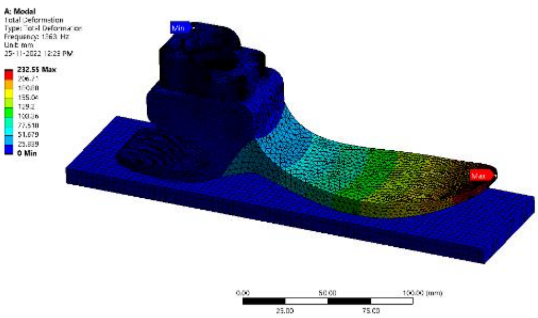

Figure 38: Total deformation (Hz)

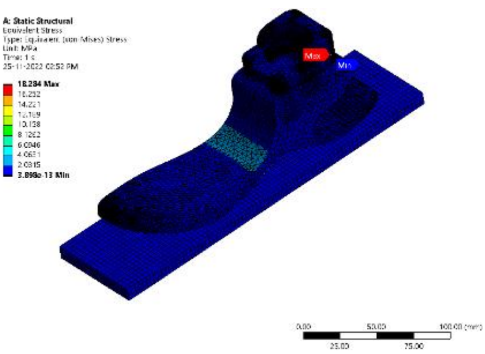

Figure 39: Equivalent Stress

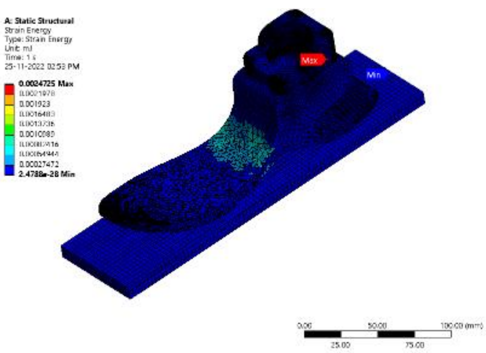

Figure 40: Strain Energy

Prosthetic foot "Heel strike" Analysis

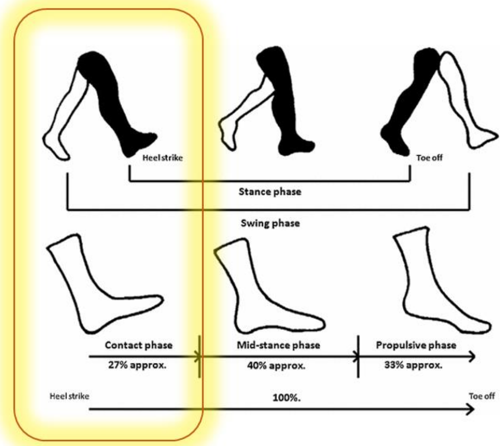

Figure 41: Prosthetic foot Model 2 in "Heel strike" situation

Table 2: Heel strike analysis on prosthetic foot model 2

Sr no.	Materials	Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	ABS	179.65	0.01028	8.0485	0.00098609
2	ABS+PC PLASTIC	178.19	0.009793	8.0528	0.00093959
3	ACETAL RESIN	169.89	0.0085314	8.0697	0.00082101
4	CFRC	213.57	0.002867	14.553	0.00028197
5	NYLON 6/6	135.19	0.016631	7.9983	0.0015791
6	PEEK	203.18	0.006386	8.0444	0.000611
7	PET	174.16	0.0084673	8.09	0.0008177
8	PLA	196.7	0.007118	8.086	0.000687
9	UHMW-PE	595.85	0.002459	50.798	0.0018742

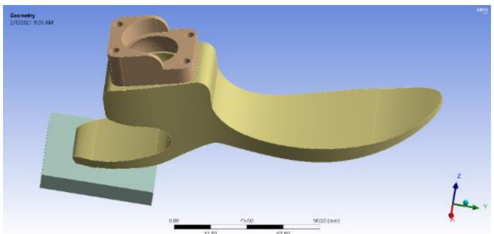

Figure 42: Prosthetic foot geometry

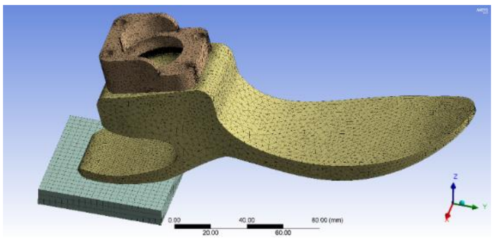

Figure 43: Mesh model

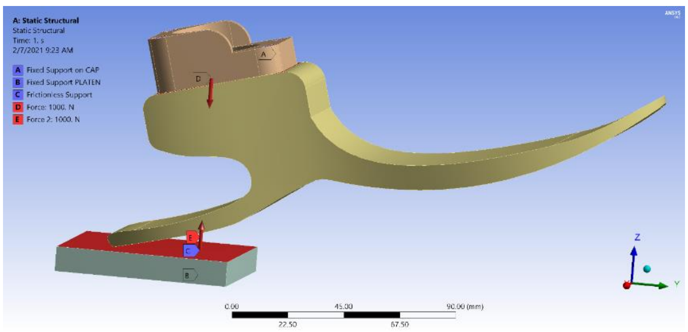

Figure 44: Static structural simulation

A) ABS

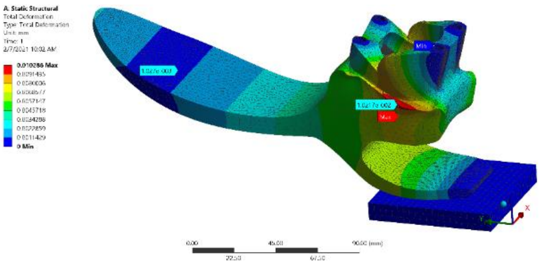

Figure 45: Total deformation (mm)

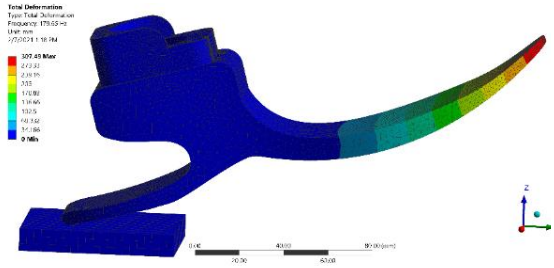

Figure 46: Total deformation (Hz)

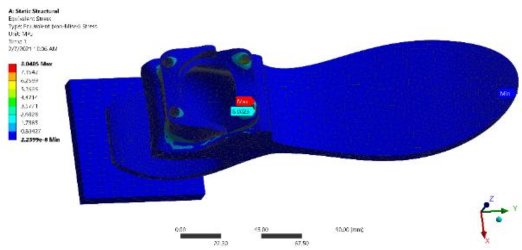

Figure 47: Equivalent Stress

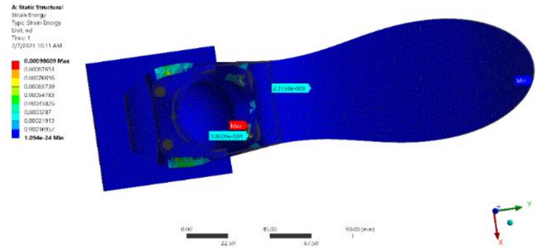

Figure 48: Strain Energy

B) ABS+ PC Plastic

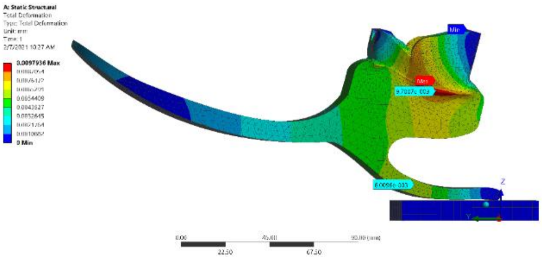

Figure 49: Total deformation (mm)

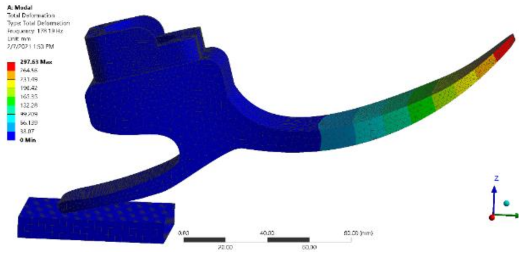

Figure 50: Total deformation (Hz)

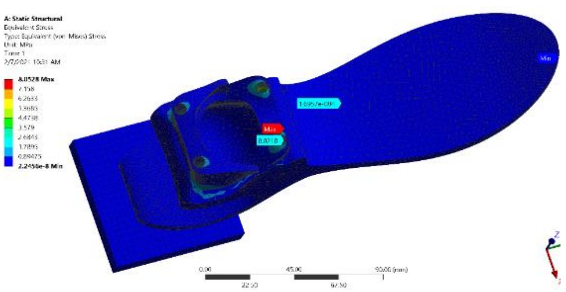

Figure 51: Equivalent Stress

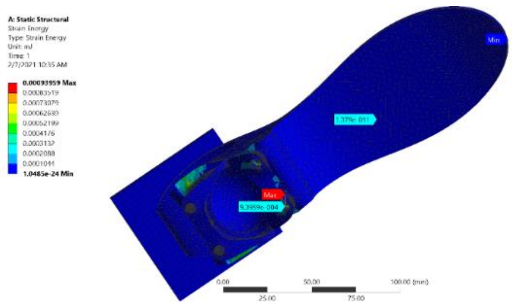

Figure 52: Strain Energy

C) ACETAL RESIN

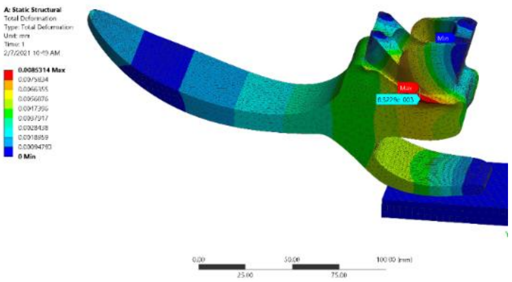

Figure 53: Total deformation (mm)

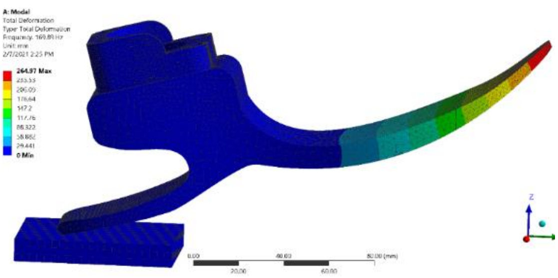

Figure 54: Total deformation (Hz)

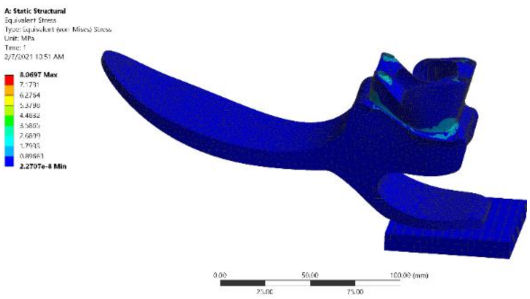

Figure 55: Equivalent Stress

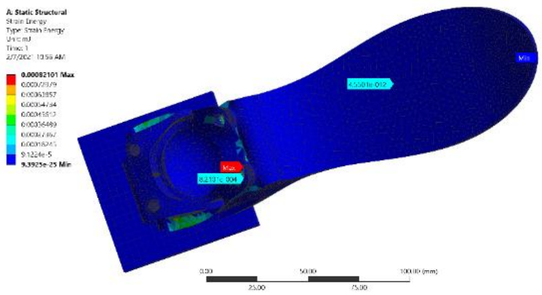

Figure 56: Strain Energy

D) CFRC

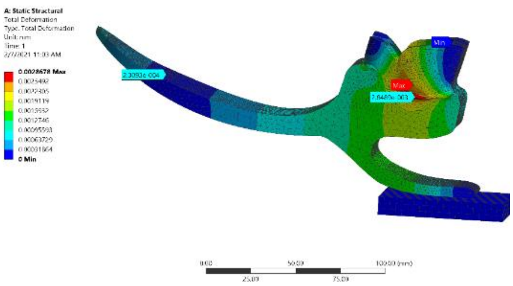

Figure 57: Total deformation (mm)

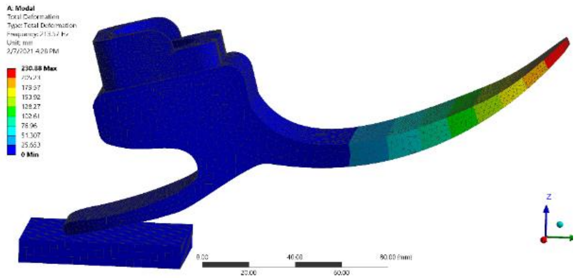

Figure 58: Total deformation (Hz)

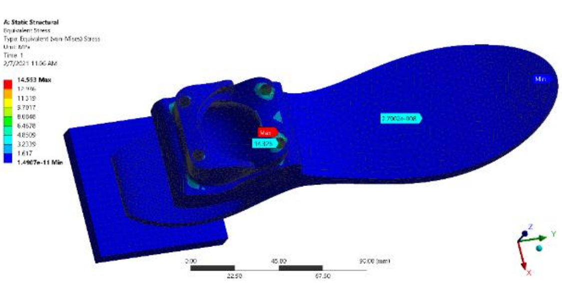

Figure 59: Equivalent Stress

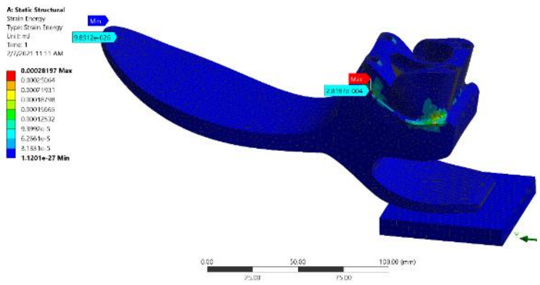

Figure 60: Strain Energy

E) NYLON 6/6

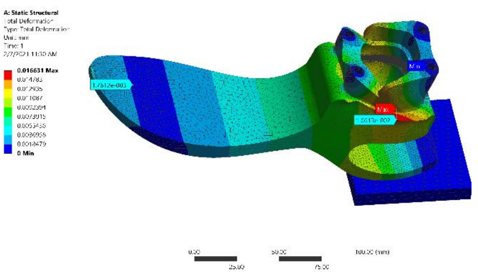

Figure 61: Total deformation (mm)

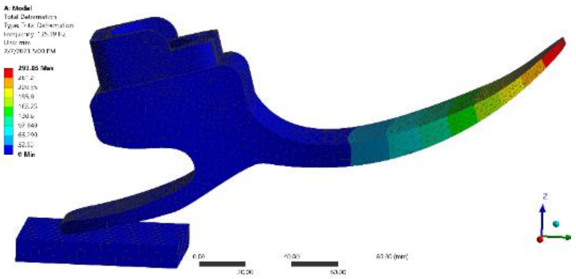

Figure 62: Total deformation (Hz)

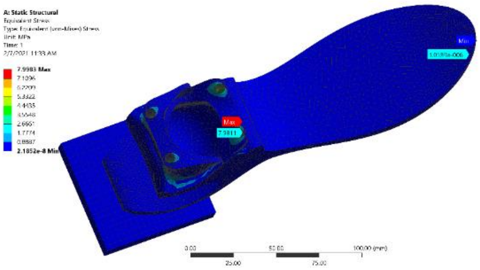

Figure 63: Equivalent Stress

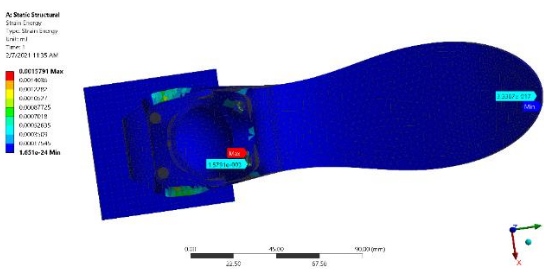

Figure 64: Strain Energy

F) PEEK

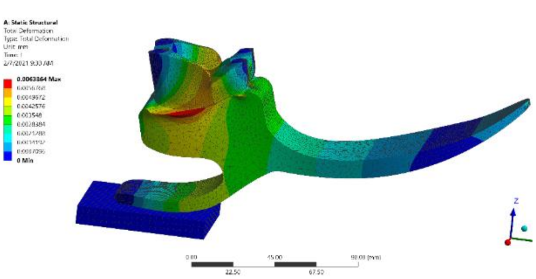

Figure 65: Total deformation (mm)

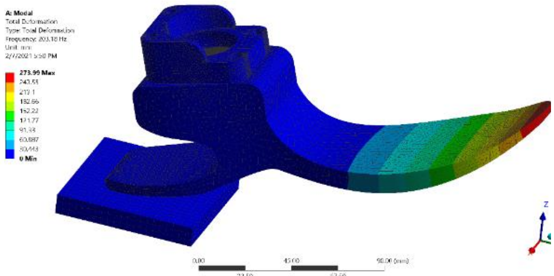

Figure 66: Total deformation (Hz)

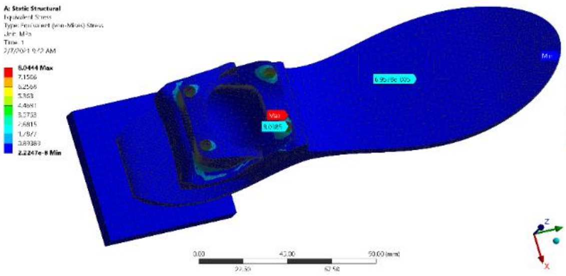

Figure 67: Equivalent Stress

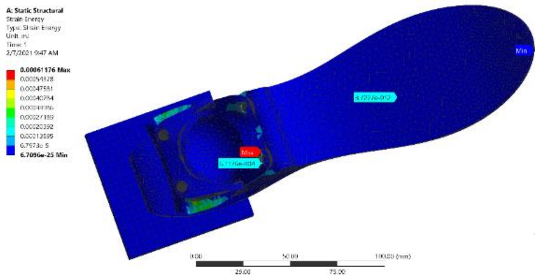

Figure 68: Strain Energy

G) PET

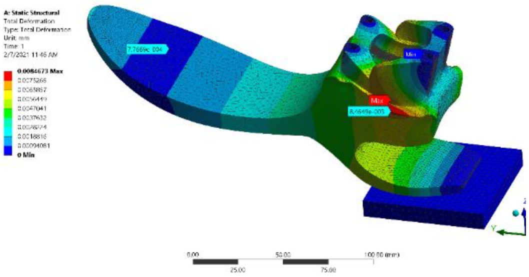

Figure 69: Total deformation (mm)

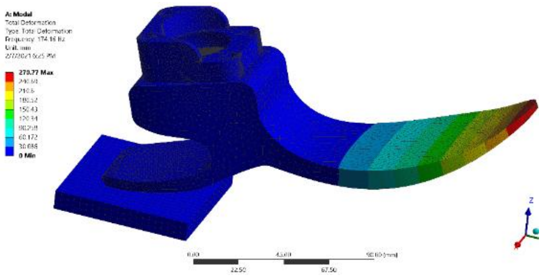

Figure 70: Total deformation (Hz)

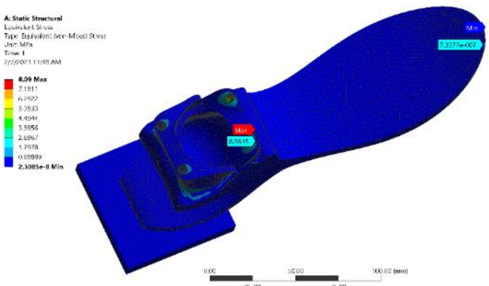

Figure 71: Equivalent Stress

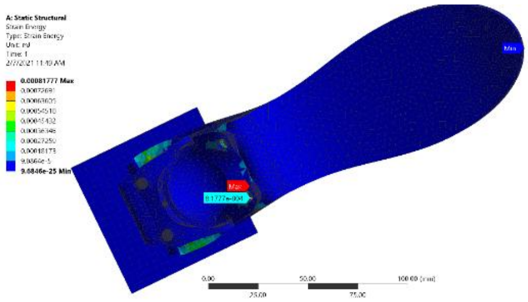

Figure 72: Strain Energy

H) PLA

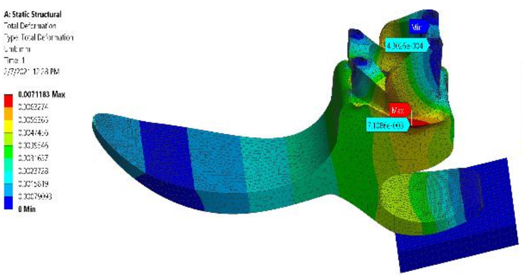

Figure 73: Total deformation (mm)

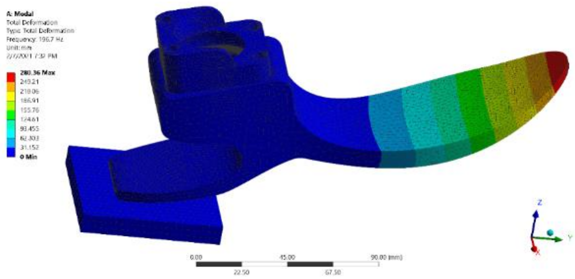

Figure 74: Total deformation (Hz)

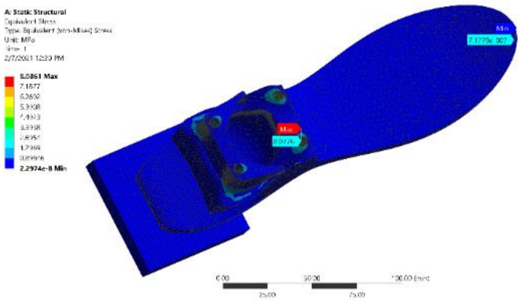

Figure 75: Equivalent Stress

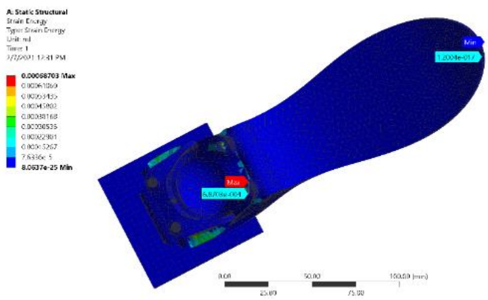

Figure 76: Strain Energy

I) UHMW-PE

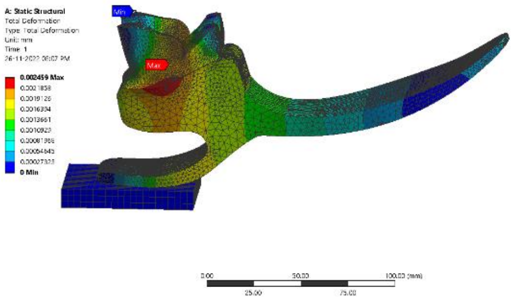

Figure 77: Total deformation (mm)

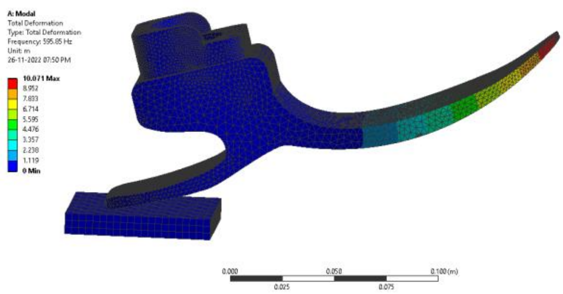

Figure 78: Total deformation (Hz)

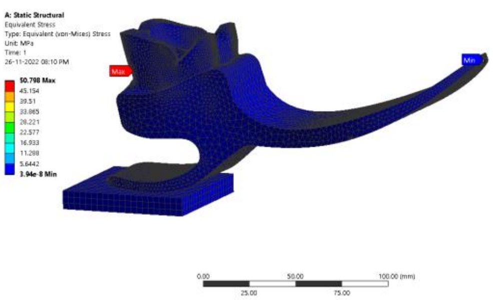

Figure 79: Equivalent Stress

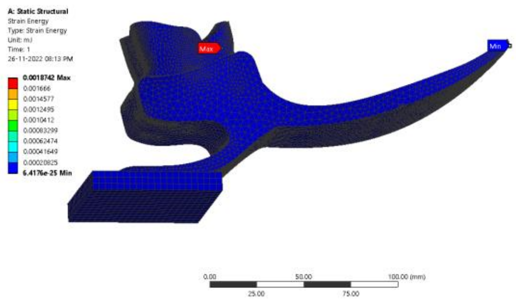

Figure 80: Strain Energy

Prosthetic foot “Toe-off” Analysis

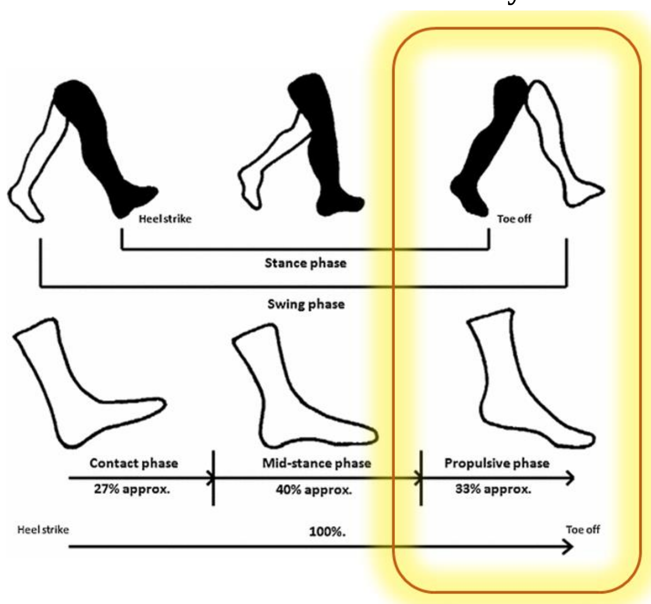

Figure 81: Prosthetic foot Model 2 in “Toe-off” situation

Table 3: Toe-off analysis on Prosthetic foot model 2

Sr no.	Materials	Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	**ABS**	492.04	0.014	16.079	0.00132
2	**ABS+PC PLASTIC**	487.99	0.0133	16.079	0.001258
3	**ACETAL RESIN**	465.08	0.01163	16.08	0.001102
4	**CFRC**	590.54	0.0032	16.21	0.000444
5	**NYLON 6/6**	370.64	0.02278	16.074	0.00209
6	**PEEK**	556.54	0.0087	16.115	0.000818
7	**PET**	476.57	0.01153	16.069	0.0011
8	**PLA**	538.29	0.0096	16.085	0.000925
9	**UHMW-PE**	1613.3	0.003536	54.322	0.00263

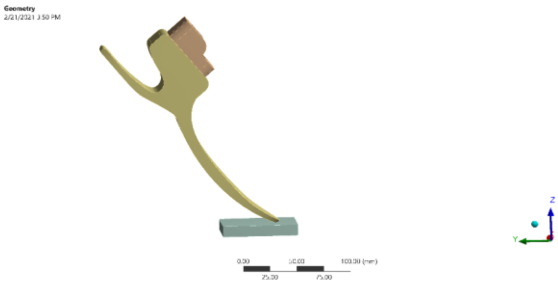

Figure 82: Prosthetic foot geometry

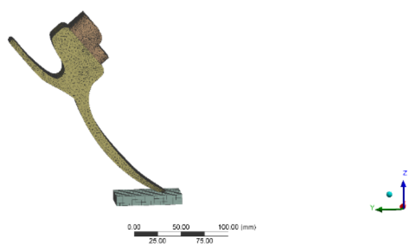

Figure 83: Mesh model

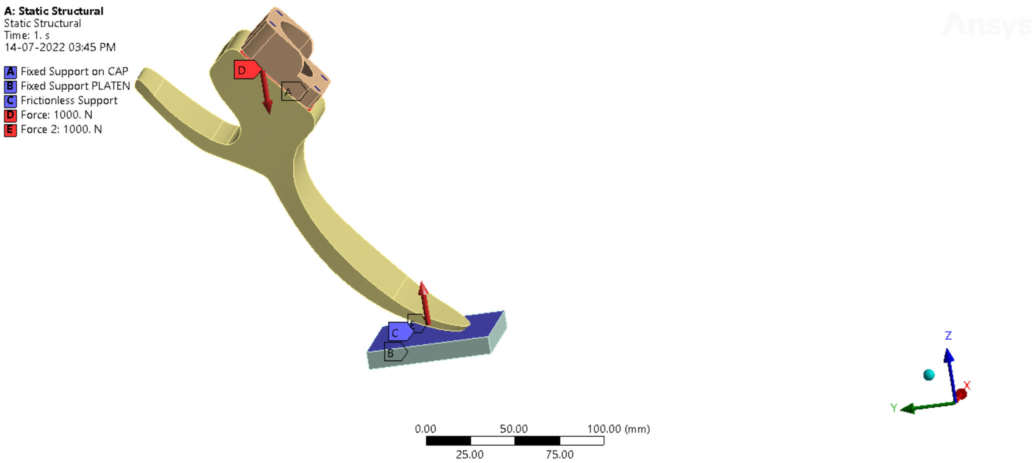

Figure 84: Static structural simulation

(A) ABS

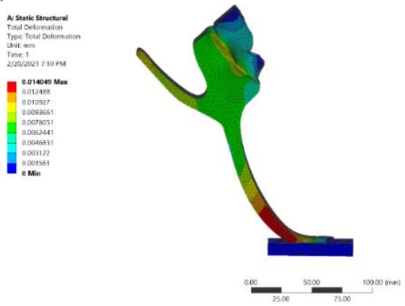

Figure 85: Total deformation (mm)

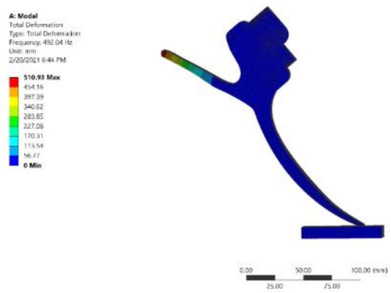

Figure 86: Total deformation (Hz)

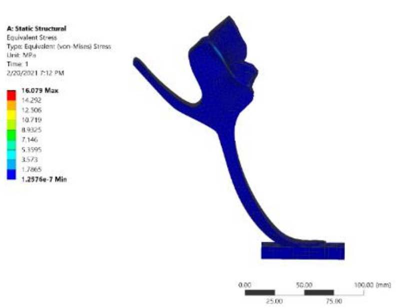

Figure 87: Equivalent Stress

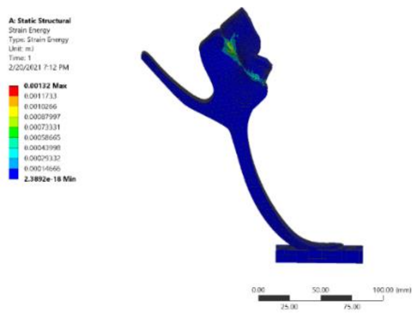

Figure 88: Strain Energy

(B) ABS+ PC Plastic

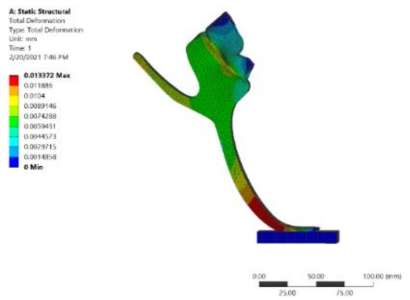

Figure 89: Total deformation (mm)

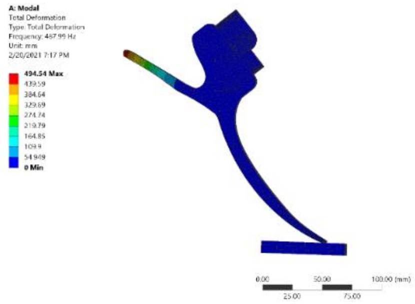

Figure 90: Total deformation (Hz)

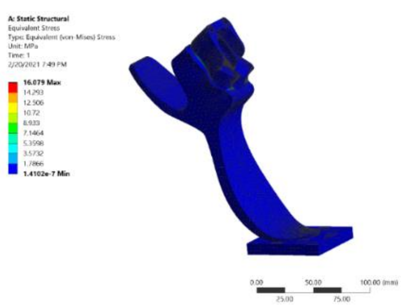

Figure 91: Equivalent Stress

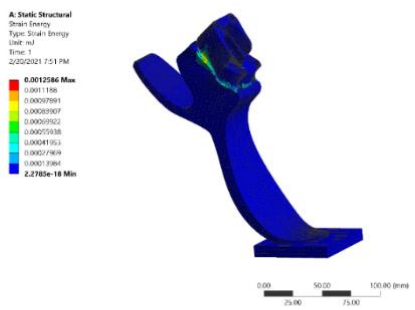

Figure 92: Strain Energy

(C) ACETAL RESIN

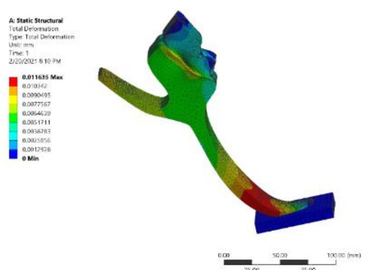

Figure 93: Total deformation (mm)

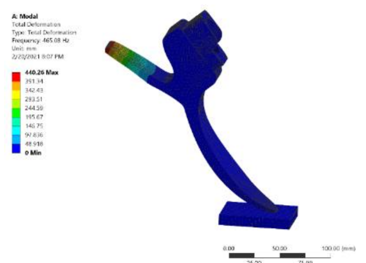

Figure 94: Total deformation (Hz)

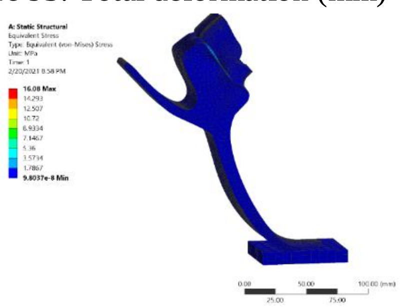

Figure 95: Equivalent Stress

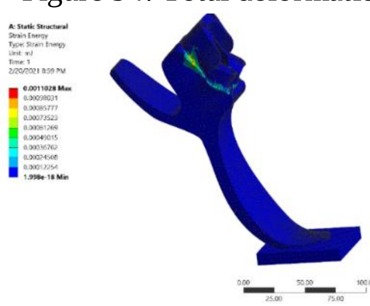

Figure 96: Strain Energy

(D) CFRC

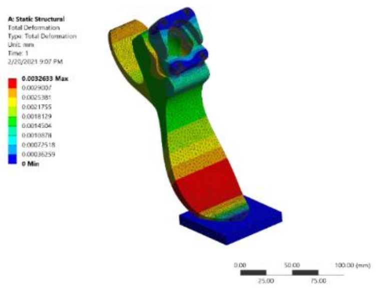

Figure 97: Total deformation (mm)

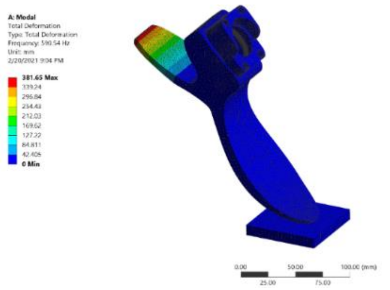

Figure 98: Total deformation (Hz)

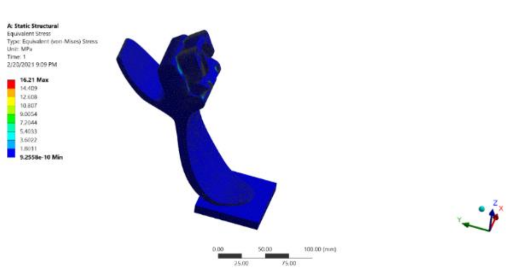

Figure 99: Equivalent Stress

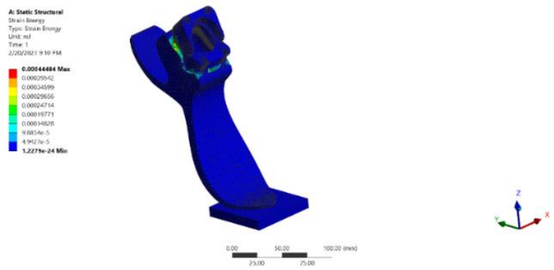

Figure 100: Strain Energy

(E) NYLON 6/6

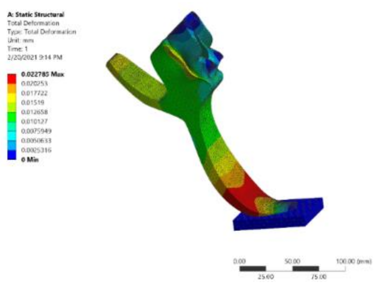

Figure 101: Total deformation (mm)

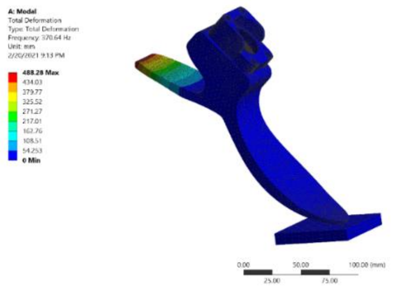

Figure 102: Total deformation (Hz)

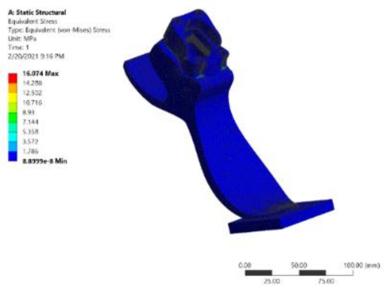

Figure 103: Equivalent Stress

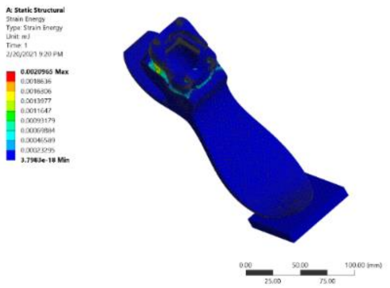

Figure 104: Strain Energy

(F) PEEK

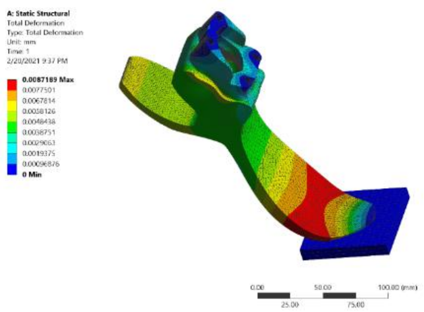

Figure 105: Total deformation (mm)

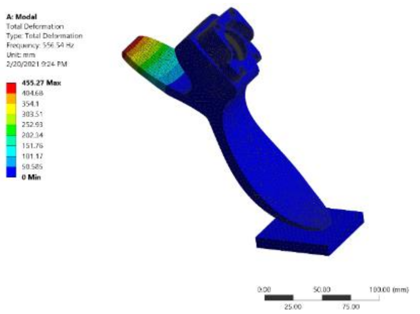

Figure 106: Total deformation (Hz)

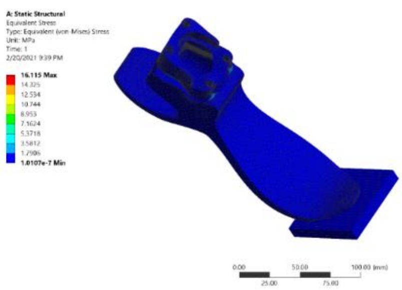

Figure 107: Equivalent Stress

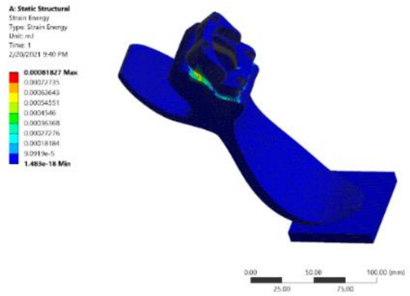

Figure 108: Strain Energy

(G)PET

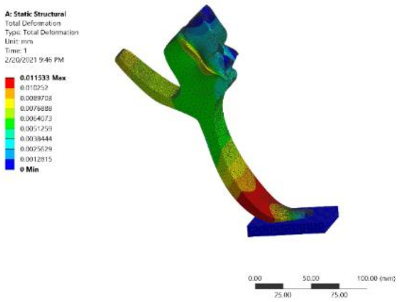

Figure 109: Total deformation (mm)

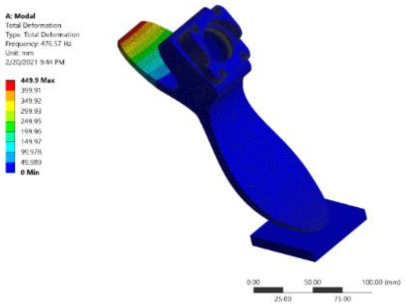

Figure 110: Total deformation (Hz)

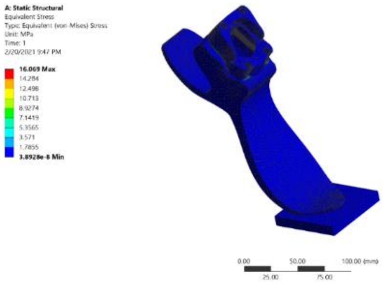

Figure 111: Equivalent Stress

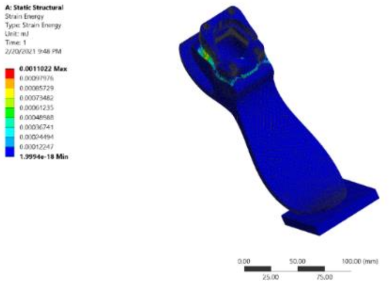

Figure 112: Strain Energy

(H)PLA

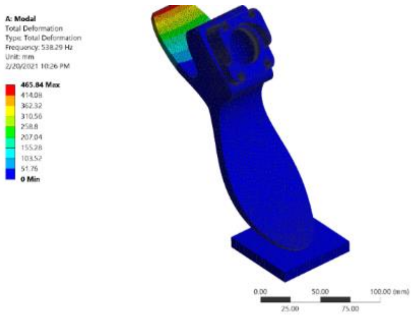

Figure 113: Total deformation (Hz)

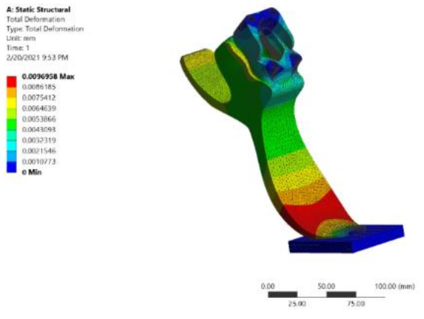

Figure 114: Total deformation (mm)

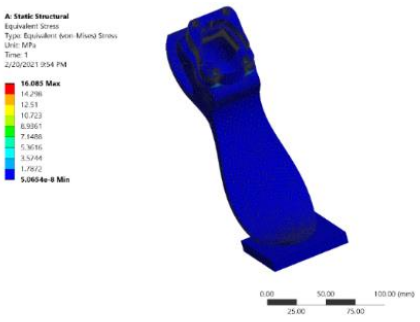

Figure 115: Equivalent Stress

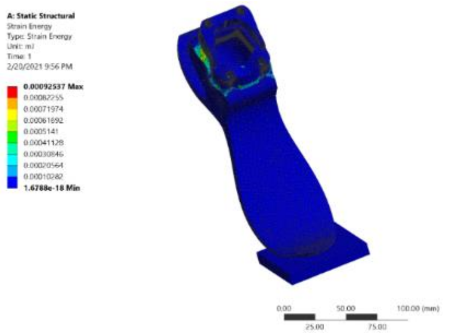

Figure 116: Strain Energy

(I) UHME-PE

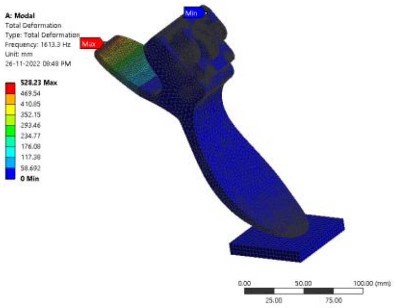

Figure 117: Total deformation (Hz)

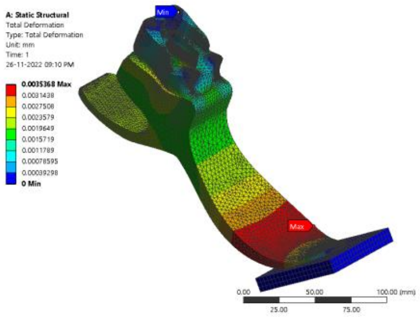

Figure 118: Total deformation (mm)

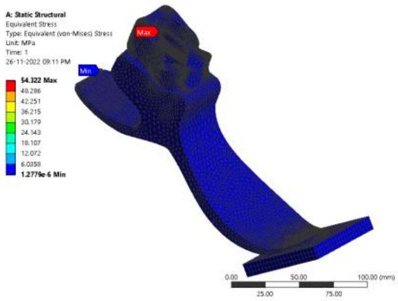

Figure 119: Equivalent Stress

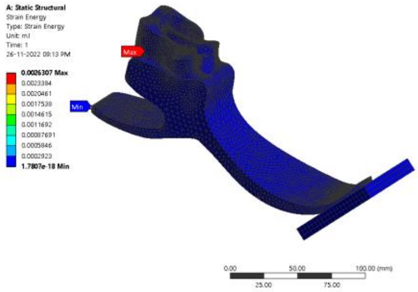

Figure 120: Strain Energy

Midstance analysis for various configuration models

Prosthetic Foot Model 1

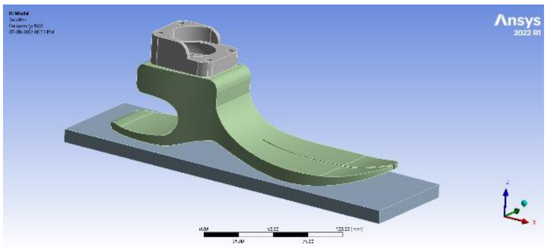

Figure 121: Prosthetic foot Model 1 geometry

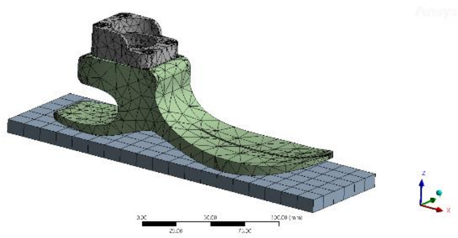

Figure 122: Mesh model

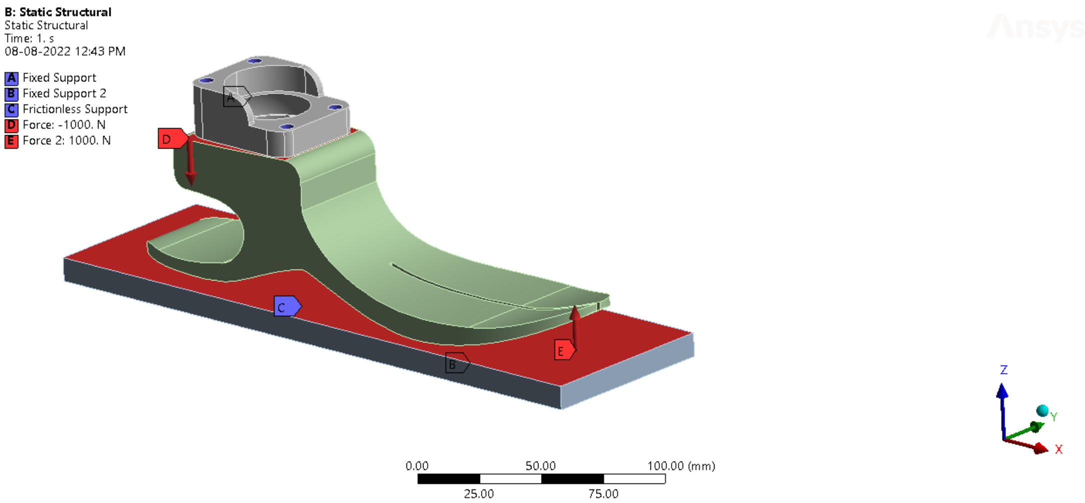

Figure 123: Static structural simulation

Table 4: Midstance analysis on prosthetic foot model 1

Sr no.	Materials	Prosthetic Foot Model 1			
		Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	ABS	1040.5	0.0084	7.5696	0.00694
2	ABS+PC PLASTIC	1031.9	0.00817	7.5486	0.0066
3	ACETAL RESIN	983.41	0.00755	7.4864	0.0059
4	CFRC	4932.2	0.00371	25.289	0.00376
5	NYLON 6/6	783.83	0.01103	7.7744	0.01049
6	PEEK	1176.4	0.0064	9.3241	0.0046
7	PET	1007.8	0.007524	7.4765	0.005896
8	PLA	1138.1	0.006817	8.5308	0.005071
9	UHMW-PE	3429.9	0.00202	22.761	0.0027

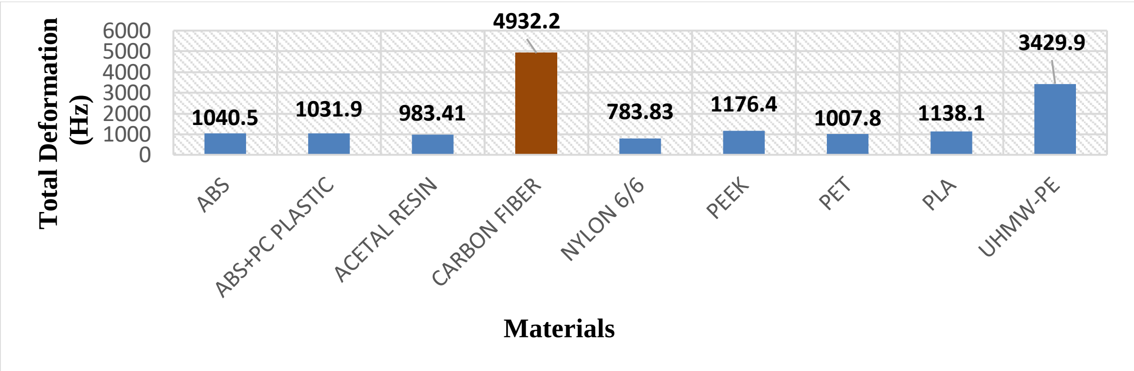

Figure 124: Total deformation in Hz for Prosthetic foot model 1 during mid-stance analysis

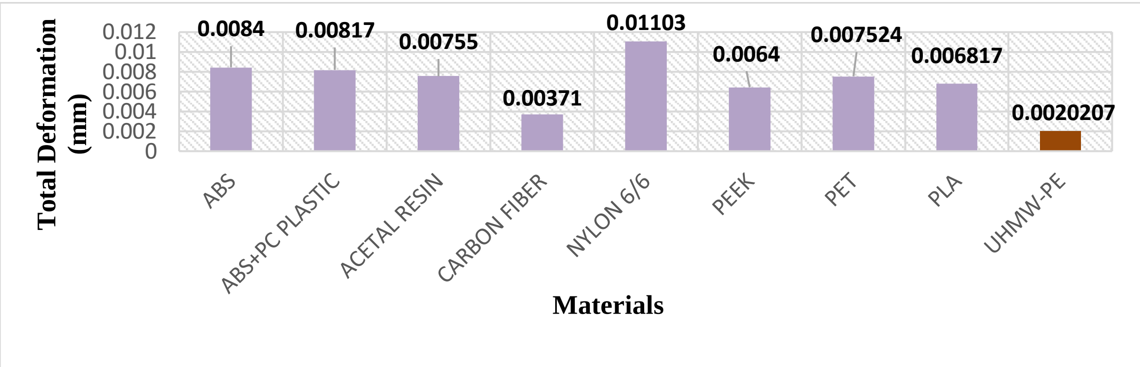

Figure 125: Total deformation in mm for Prosthetic foot model 1 during mid-stance analysis

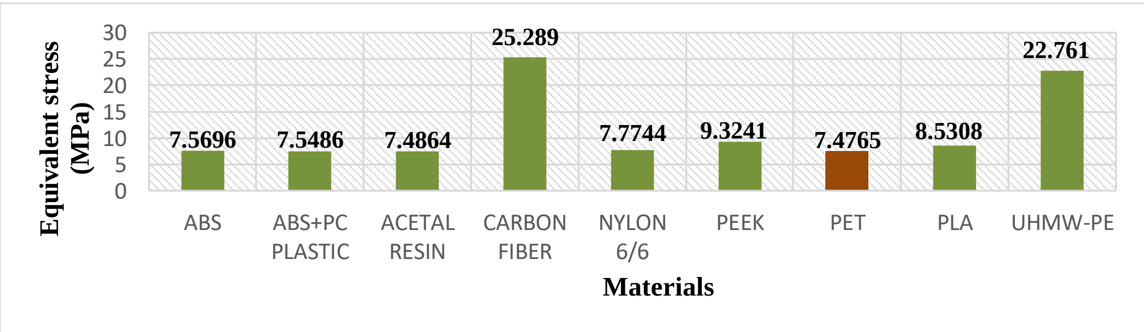

Figure 126: Equivalent stress for Prosthetic foot model 1 during mid-stance analysis

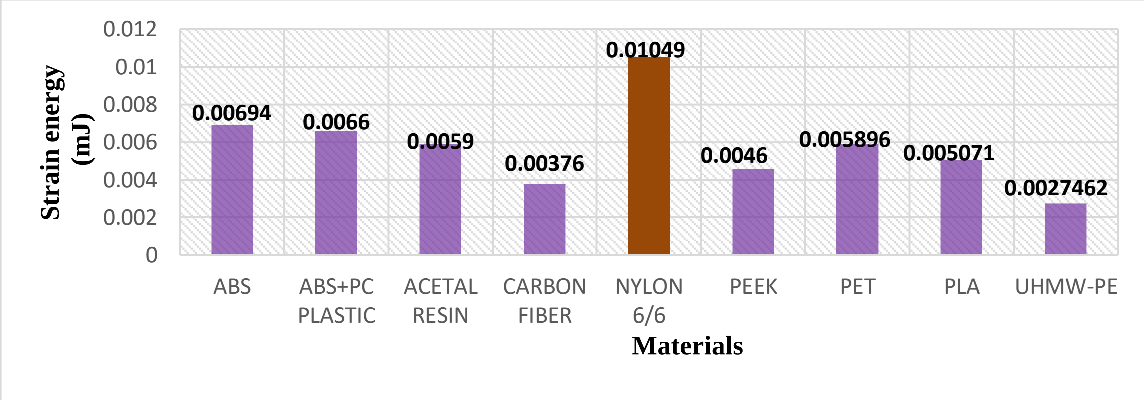

Figure 127: Strain energy for Prosthetic foot model 1 during mid-stance analysis

J) ABS

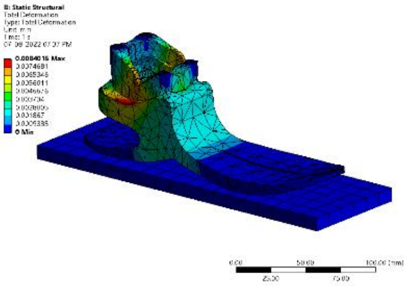

Figure 128: Total deformation (mm)

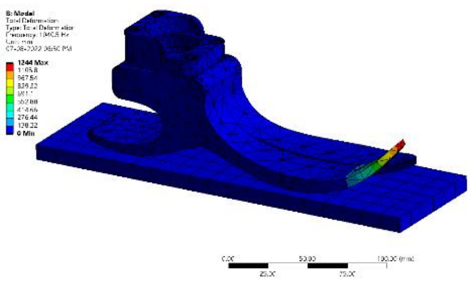

Figure 129: Total deformation (Hz)

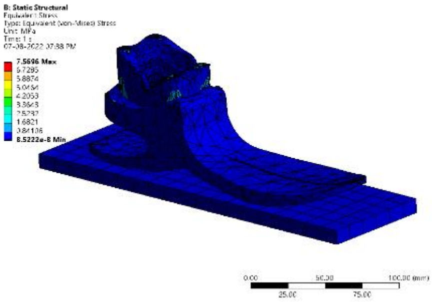

Figure 130: Equivalent Stress

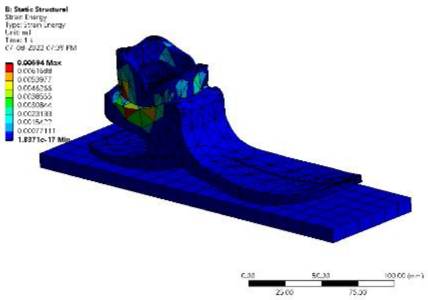

Figure 131: Strain Energy

K) ABS+ PC Plastic

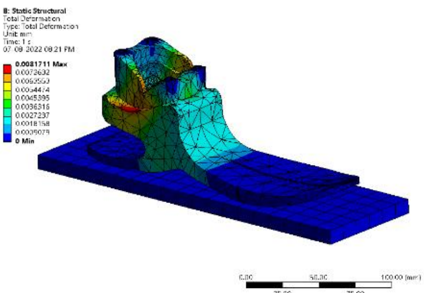

Figure 132: Total deformation (mm)

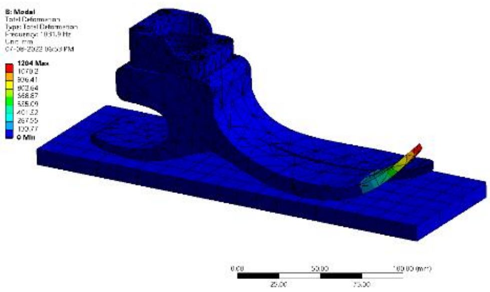

Figure 133: Total deformation (Hz)

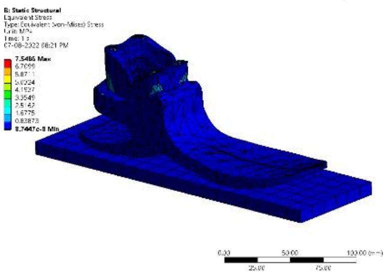

Figure 134: Equivalent Stress

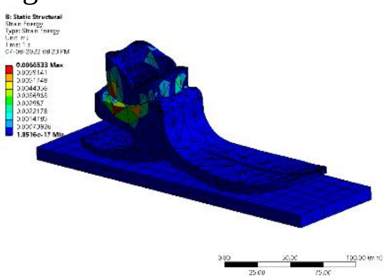

Figure 135: Strain Energy

L) ACETAL RESIN

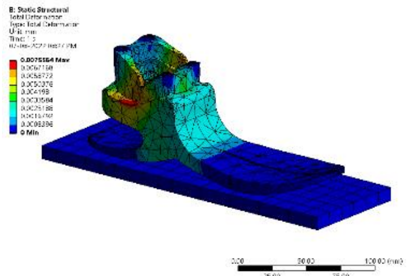

Figure 136: Total deformation (mm)

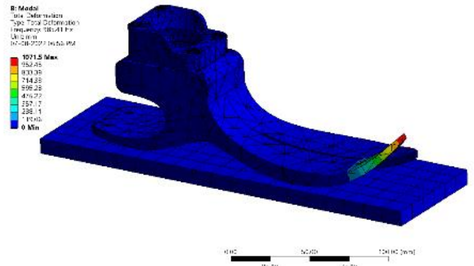

Figure 137: Total deformation (Hz)

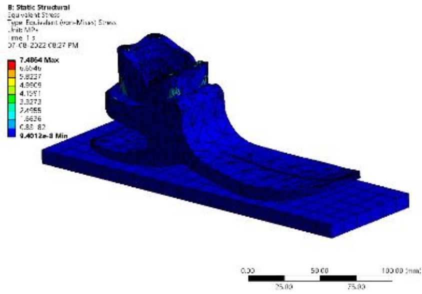

Figure 138: Equivalent Stress

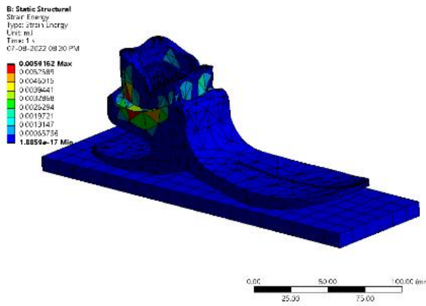

Figure 139: Strain Energy

M) CFRC

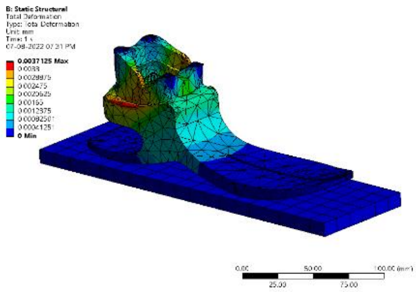

Figure 140: Total deformation (mm)

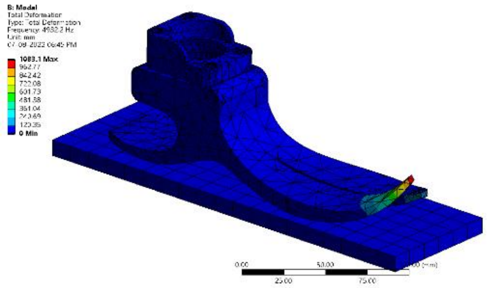

Figure 141: Total deformation (Hz)

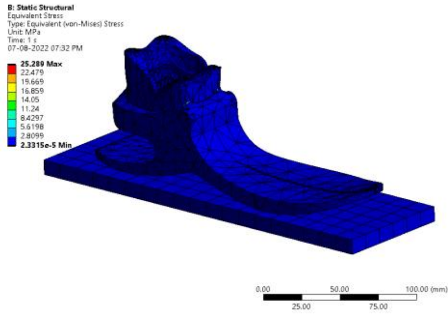

Figure 142: Equivalent Stress

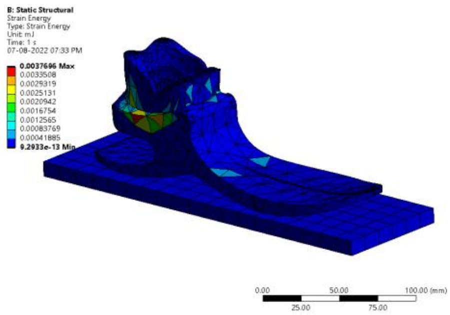

Figure 143: Strain Energy

N) NYLON 6/6

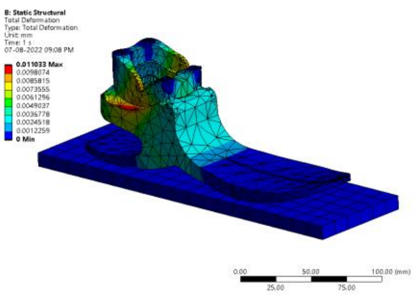

Figure 144: Total deformation (mm)

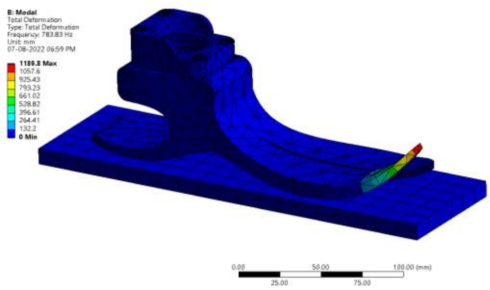

Figure 145: Total deformation (Hz)

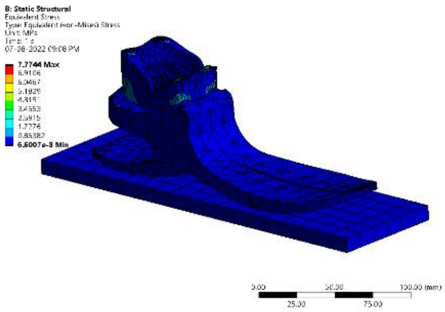

Figure 146: Equivalent Stress

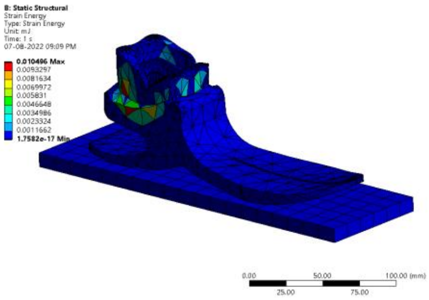

Figure 147: Strain Energy

O) PEEK

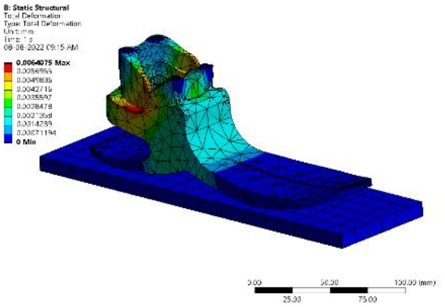

Figure 148: Total deformation (mm)

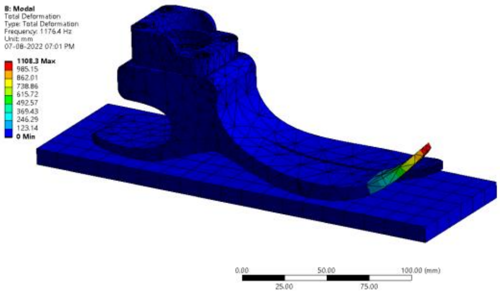

Figure149: Total deformation (Hz)

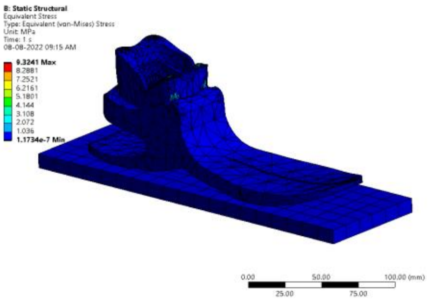

Figure 150: Equivalent Stress

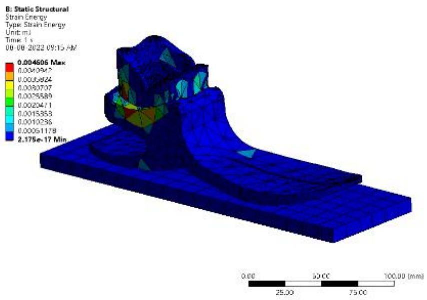

Figure 151: Strain Energy

P) PET

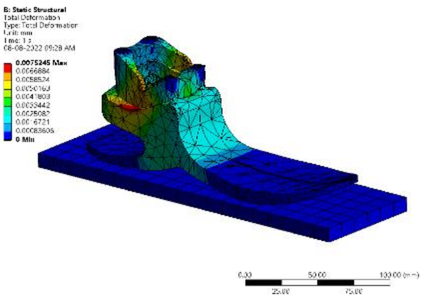

Figure 152: Total deformation (mm)

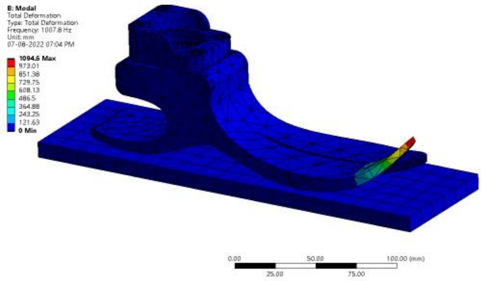

Figure 153: Total deformation (Hz)

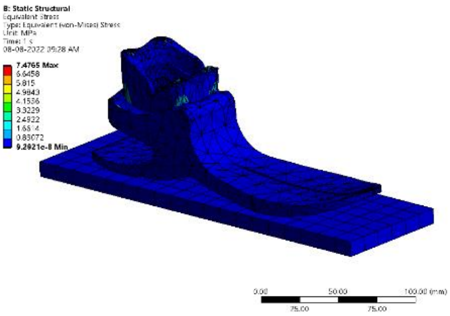

Figure 154: Equivalent Stress

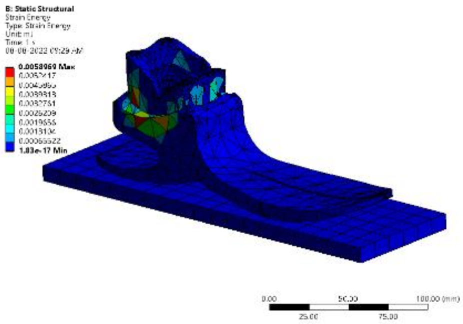

Figure 155: Strain Energy

Q) PLA

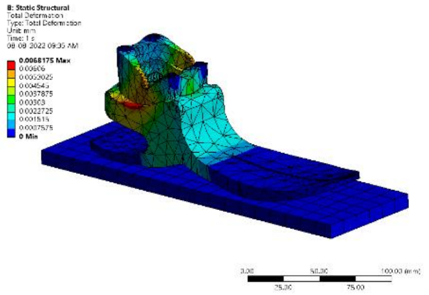

Figure 156: Total deformation (mm)

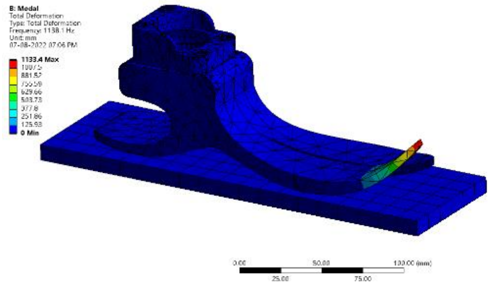

Figure 157: Total deformation (Hz)

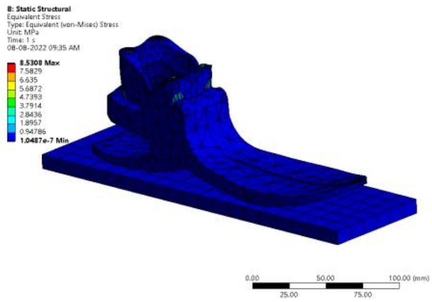

Figure 158: Equivalent Stress

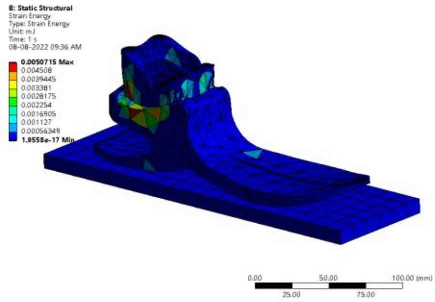

Figure 159: Strain Energy

R) UHMW-PE

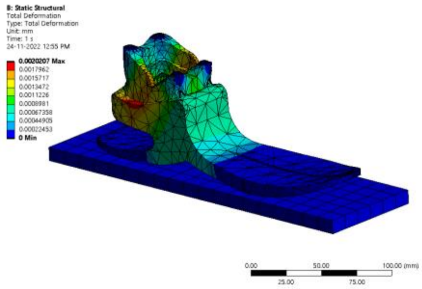

Figure 160: Total deformation (mm)

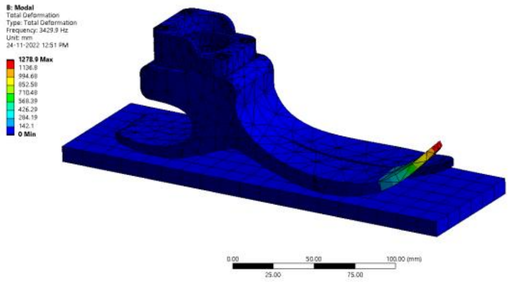

Figure 161: Total deformation (Hz)

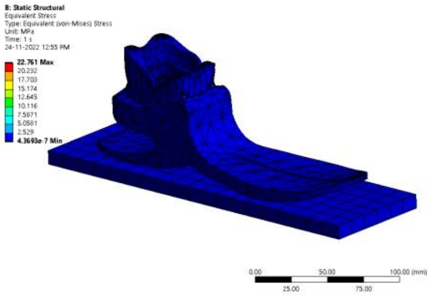

Figure 162: Equivalent Stress

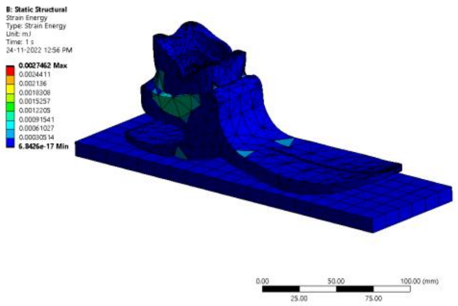

Figure 163: Strain Energy

Prosthetic Foot Model 3

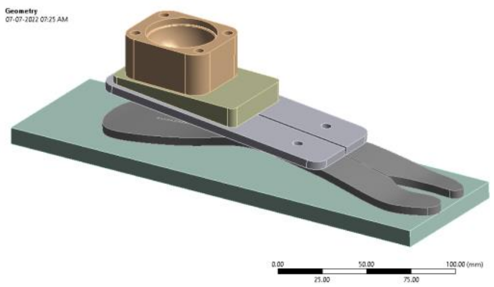

Figure 164: Prosthetic foot geometry

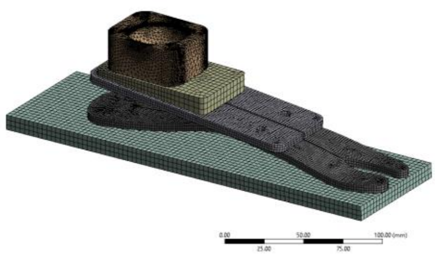

Figure 165: Mesh model

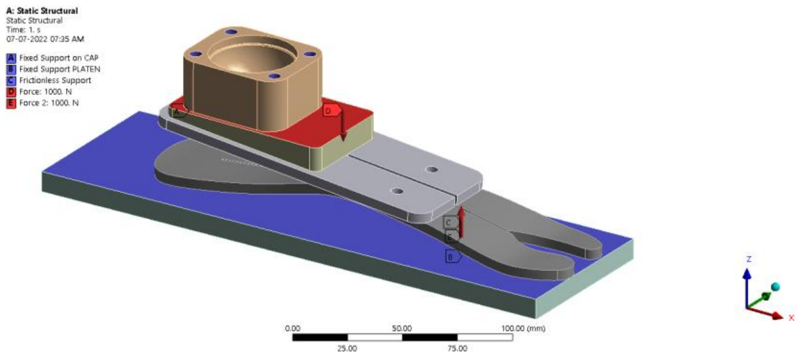

Figure 166: Static structural simulation

Table 5: Midstance analysis on prosthetic foot model 3

Sr no.	Materials	Prosthetic Foot Model 3			
		Total deformation (Hz)	**Total deformation (mm)**	**Equivalent stress (MPa)**	**Strain energy (mJ)**
1	**ABS**	663.33	0.0499	6.8566	0.04786
2	**ABS+PC PLASTIC**	640.42	0.04696	7.375	0.04486
3	**ACETAL RESIN**	610.35	0.04152	6.8781	0.04001
4	**CFRC**	3103.1	0.00261	13.566	0.00389
5	**NYLON 6/6**	486.45	0.07561	9.5337	0.07011
6	**PEEK**	730.23	0.03191	6.1896	0.03093
7	**PET**	625.46	0.04131	6.8672	0.04003
8	**PLA**	706.4	0.035309	6.2459	0.03438
9	**UHMW-PE**	1913.3	0.005605	9.428	0.007

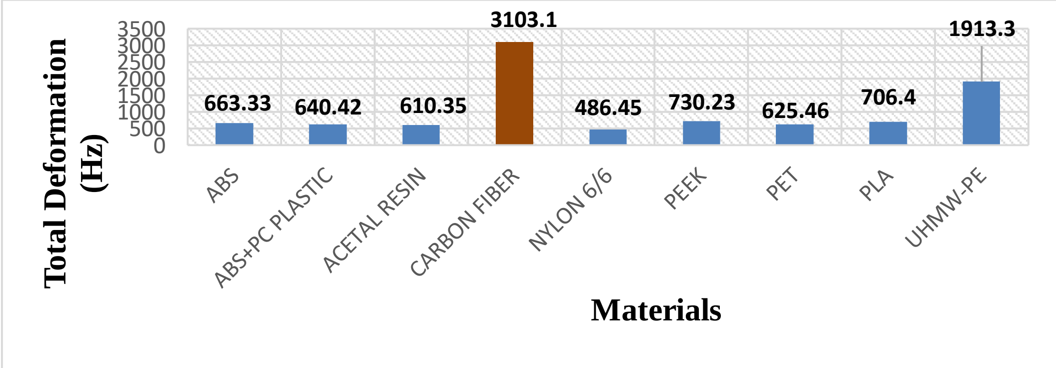

Figure 167: Total deformation in Hz for Prosthetic foot model 1 during mid-stance analysis

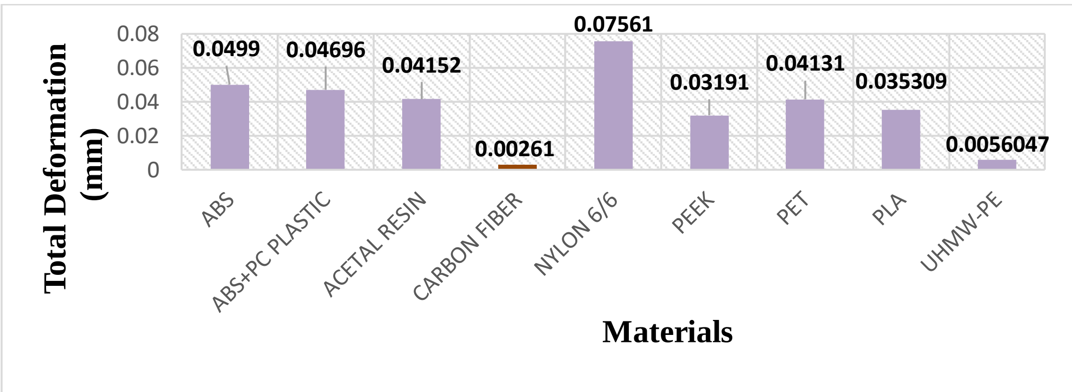

Figure 168: Total deformation in mm for Prosthetic foot model 1 during mid-stance analysis

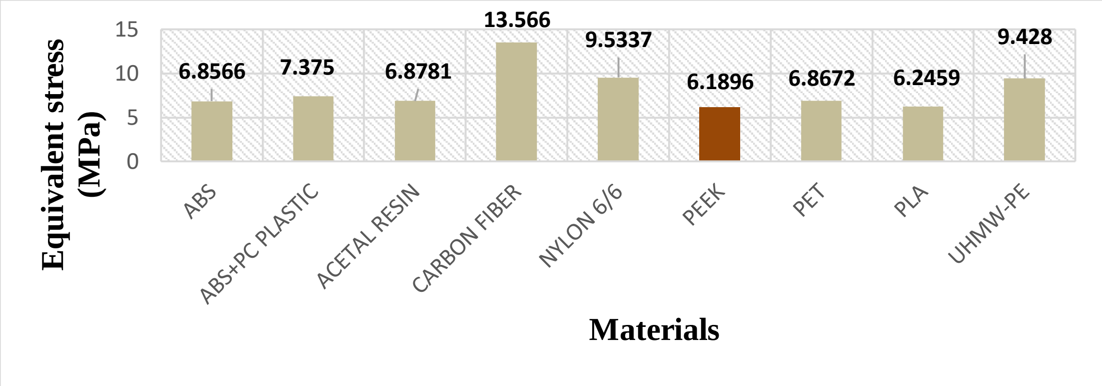

Figure 169: Equivalent stress for Prosthetic foot model 1 during mid-stance analysis

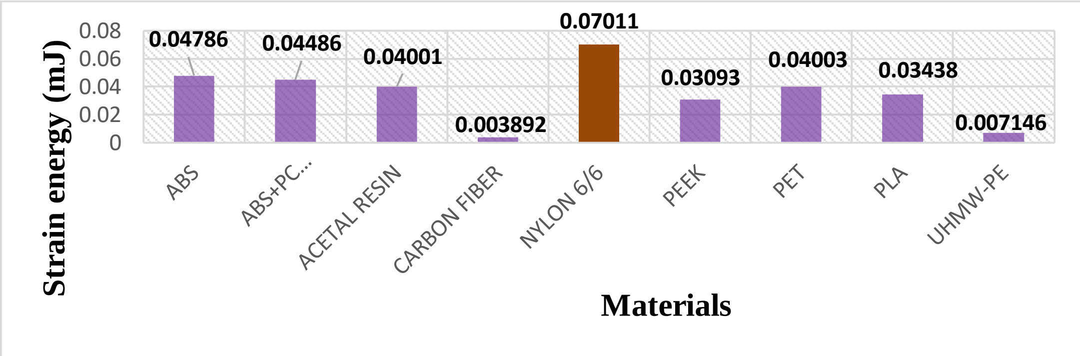

Figure 170: Strain energy for Prosthetic foot model 1 during mid-stance analysis

A) ABS

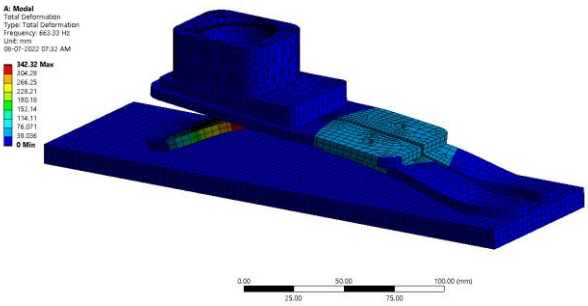

Figure 171: Total deformation (Hz)

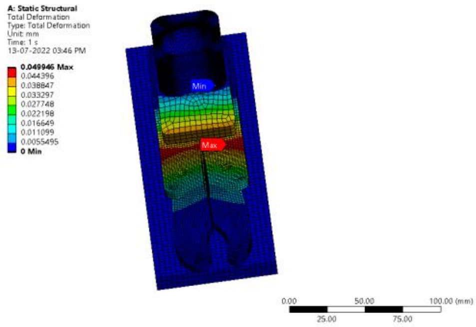

Figure 172: Total deformation (mm)

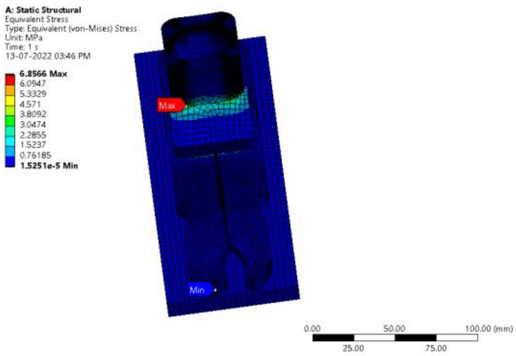

Figure 173: Equivalent Stress

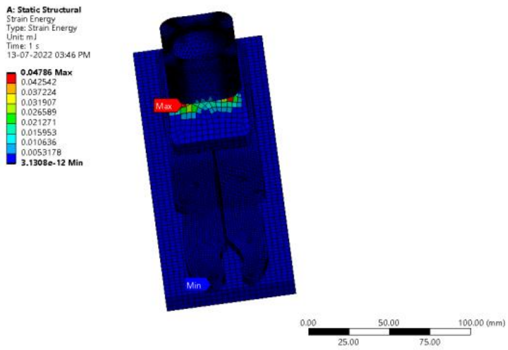

Figure 174: Strain Energy

B) ABS+ PC Plastic

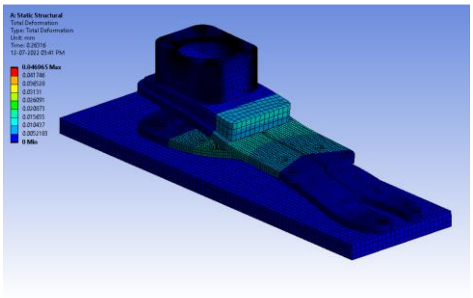

Figure 175: Total deformation (mm)

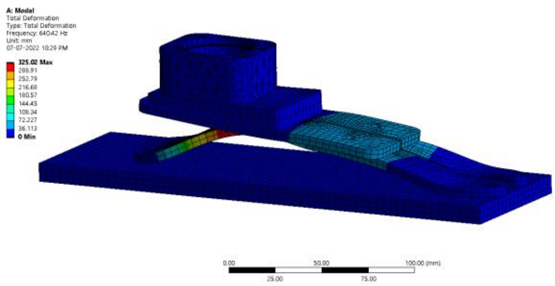

Figure 176: Total deformation (Hz)

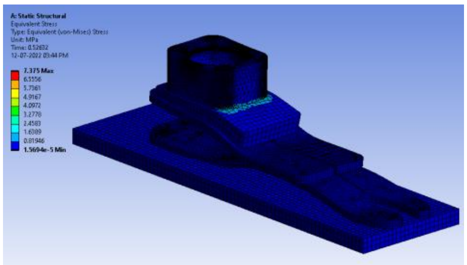

Figure 177: Equivalent Stress

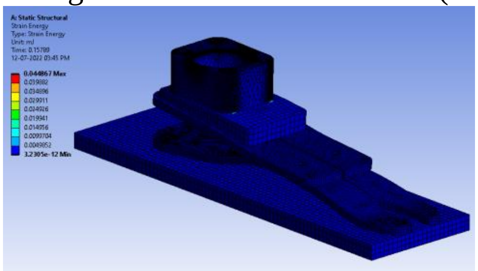

Figure 178: Strain Energy

C) ACETAL RESIN

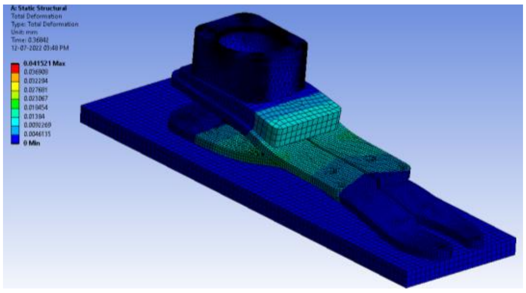

Figure 179: Total deformation (mm)

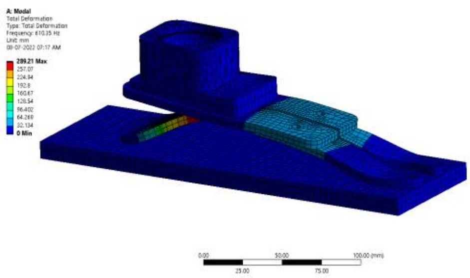

Figure 180: Total deformation (Hz)

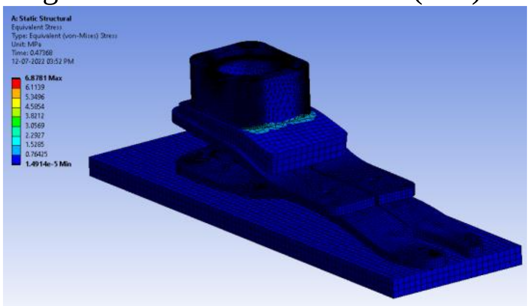

Figure 181: Equivalent Stress

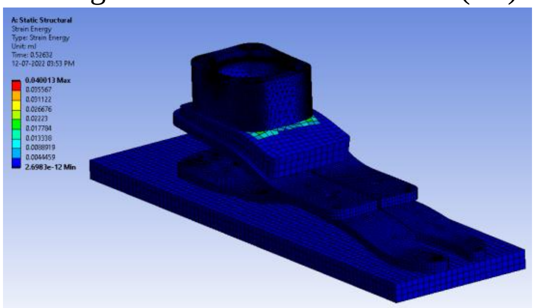

Figure 182: Strain Energy

D) CFRC

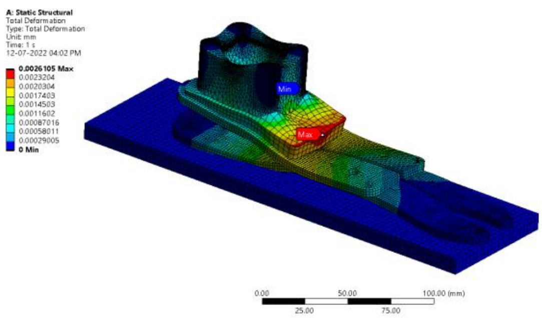

Figure 183: Total deformation (mm)

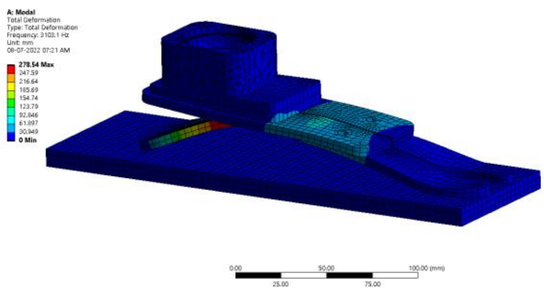

Figure 184: Total deformation (Hz)

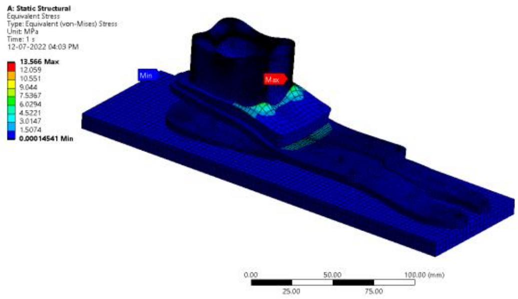

Figure 185: Equivalent Stress

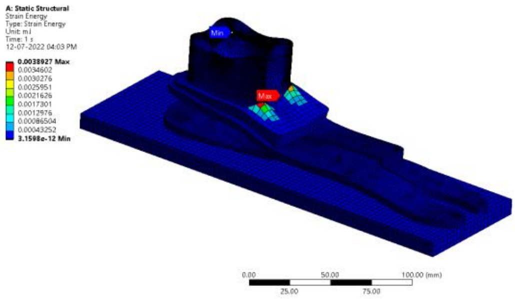

Figure 186: Strain Energy

E) NYLON 6/6

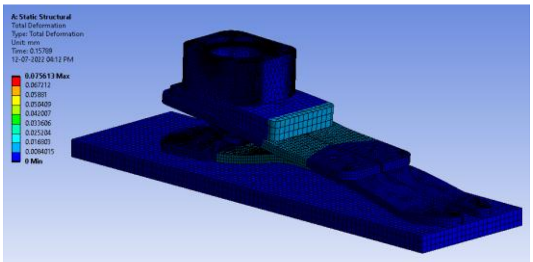

Figure 187: Total deformation (mm)

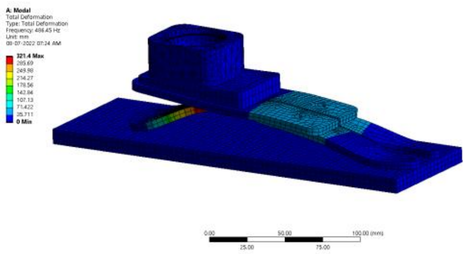

Figure 188: Total deformation (Hz)

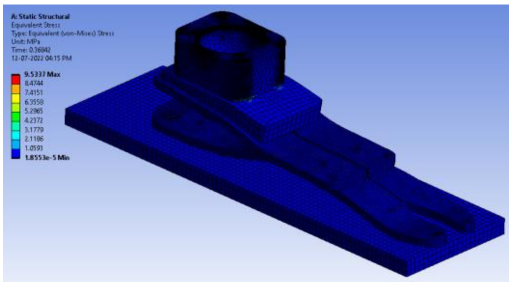

Figure 189: Equivalent Stress

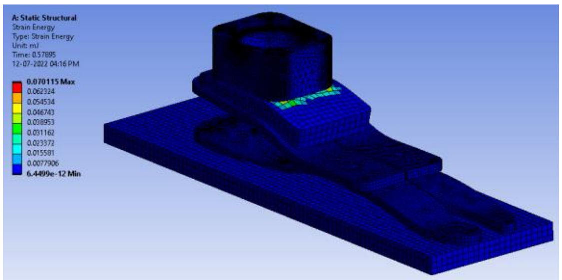

Figure 190: Strain Energy

F) PEEK

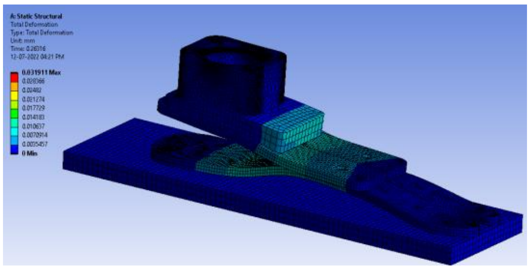

Figure 191: Total deformation (mm)

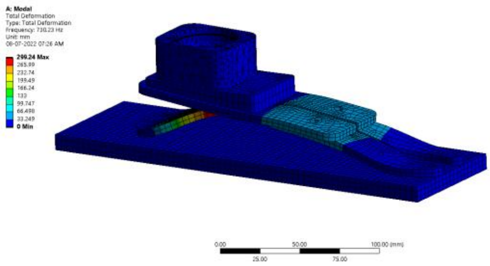

Figure 192: Total deformation (Hz)

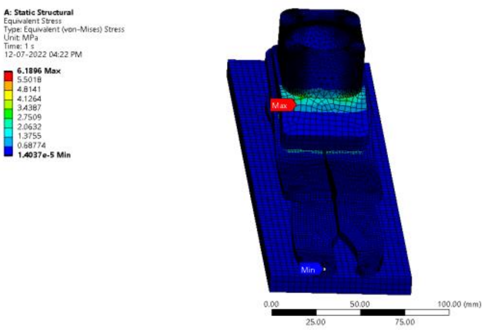

Figure 193: Equivalent Stress

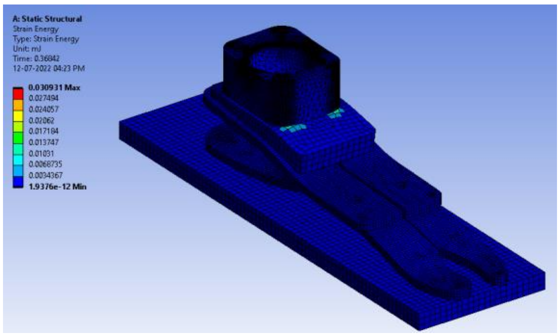

Figure 194: Strain Energy

G) PET

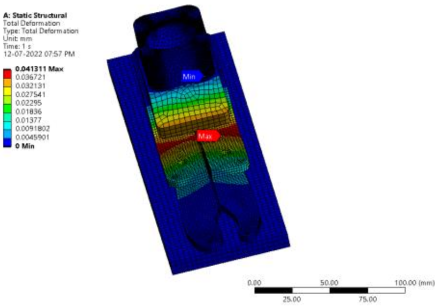

Figure 195: Total deformation (mm)

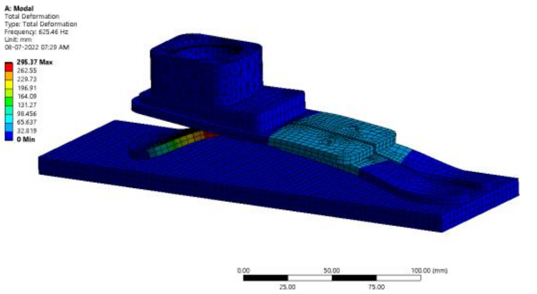

Figure 196: Total deformation (Hz)

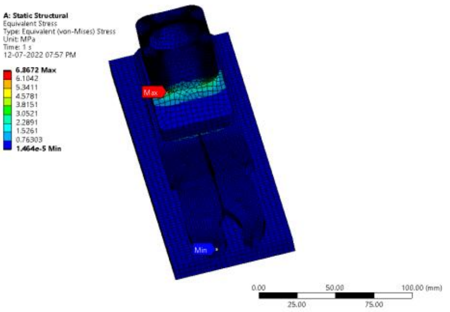

Figure 197: Equivalent Stress

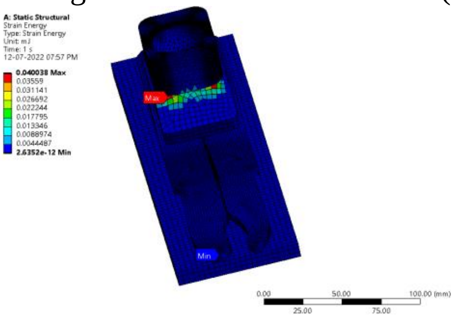

Figure 198: Strain Energy

H) PLA

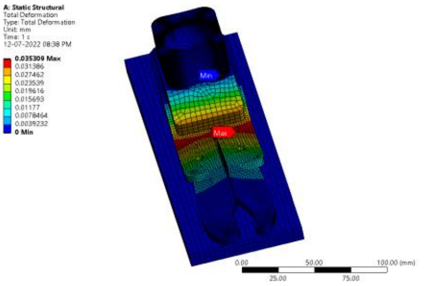

Figure 199: Total deformation (mm)

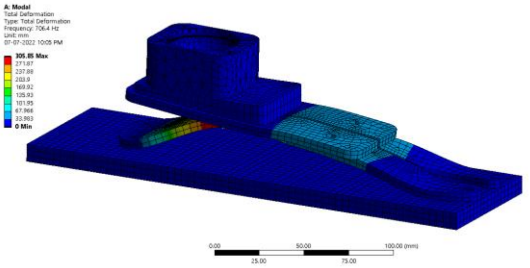

Figure 200: Total deformation (Hz)

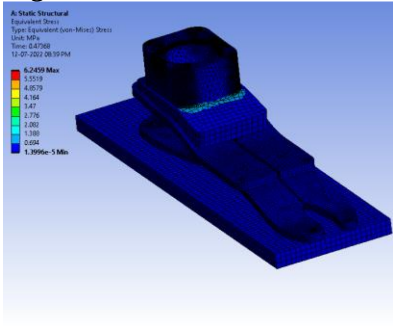

Figure 201: Equivalent Stress

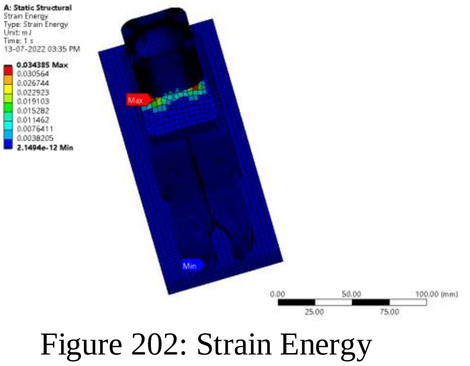

Figure 202: Strain Energy

I) UHMW-PE

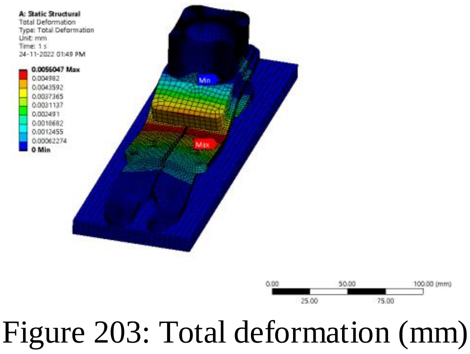

Figure 203: Total deformation (mm)

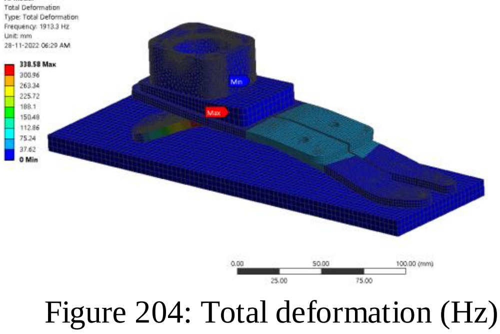

Figure 204: Total deformation (Hz)

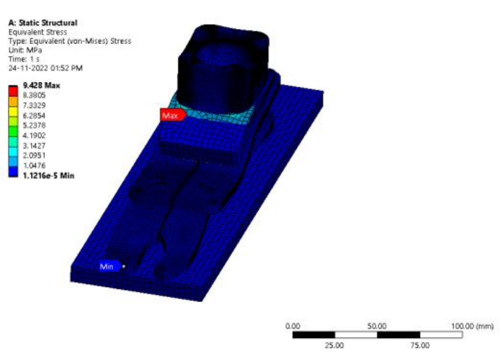

Figure 205: Equivalent Stress

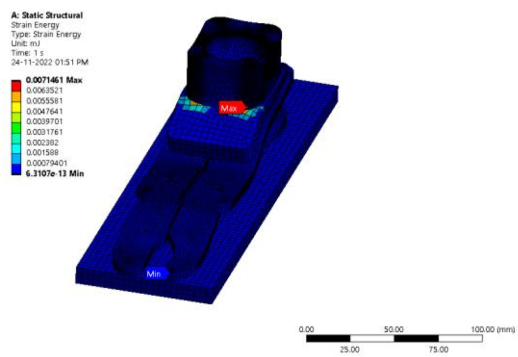

Figure 206: Strain Energy

Prosthetic Foot Model 4

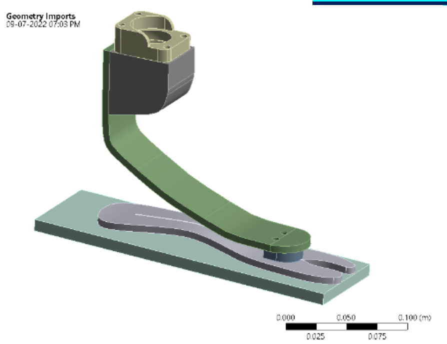

Figure 207: Prosthetic foot geometry

Figure 208: Mesh model

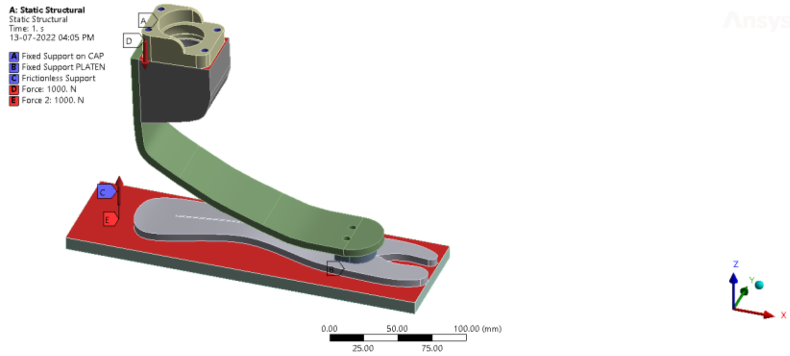

Figure 209: Static structural simulation

Table 6: Midstance analysis on prosthetic foot model 4

Sr no.	Materials	Prosthetic Foot Model 4			
		Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	ABS	471.72	0.00724	7.5111	0.0021
2	ABS+PC PLASTIC	467.82	0.0064	6.9088	0.0016
3	ACETAL RESIN	445.93	0.006	7.535	0.001745
4	CFRC	1119.5	0.00377	22.354	0.003536
5	NYLON 6/6	363.27	0.0087	6.8246	0.0015
6	PEEK	526.14	0.00524	9.4593	0.00204
7	PET	456.88	0.00599	7.5968	0.0017546
8	PLA	511.9	0.00552	8.724	0.001933
9	UHMW-PE	1561.1	0.006	7.526	0.0017

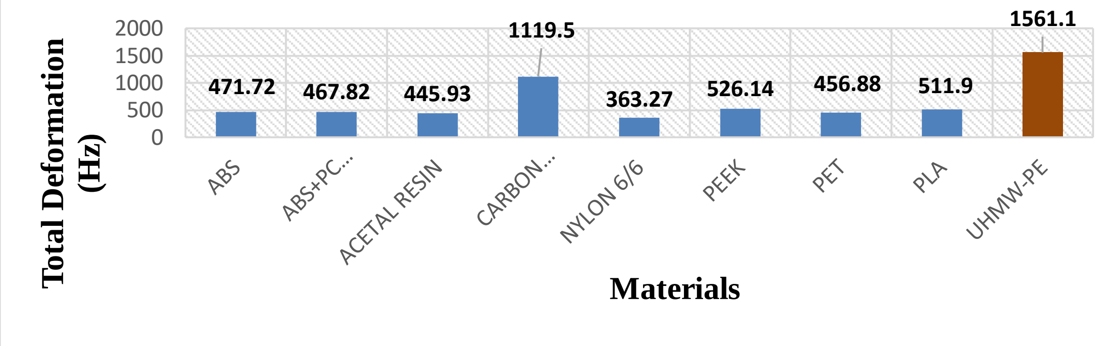

Figure 210: Total deformation in Hz for Prosthetic foot model 1 during mid-stance analysis

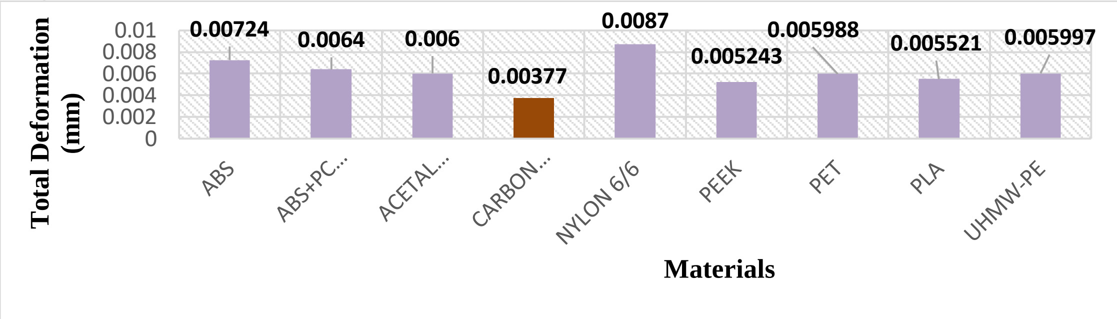

Figure 211: Total deformation in mm for Prosthetic foot model 1 during mid-stance analysis

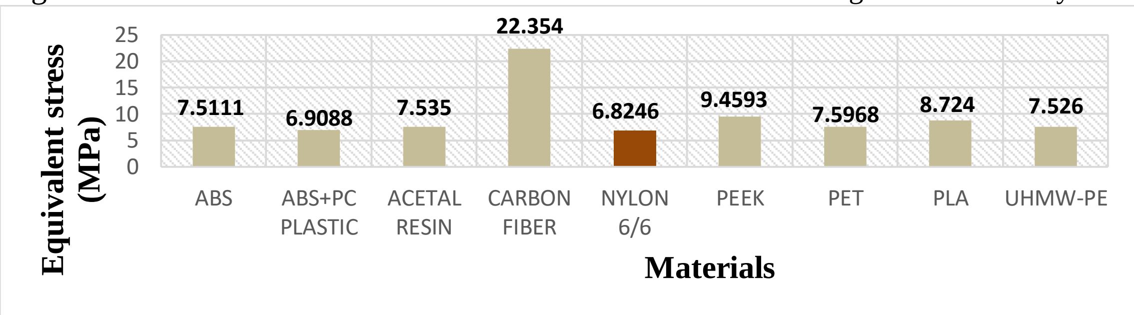

Figure 212: Equivalent stress for Prosthetic foot model 1 during mid-stance analysis

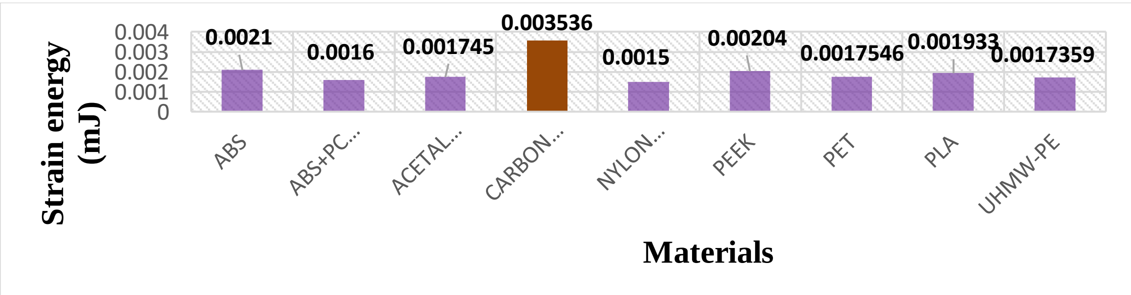

Figure 213: Strain energy for Prosthetic foot model 1 during mid-stance analysis

A) ABS

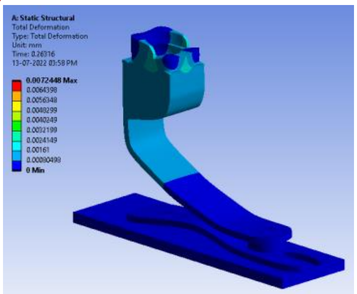

Figure 214: Total deformation (mm)

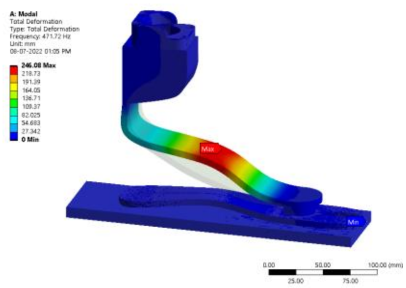

Figure 215: Total deformation (Hz)

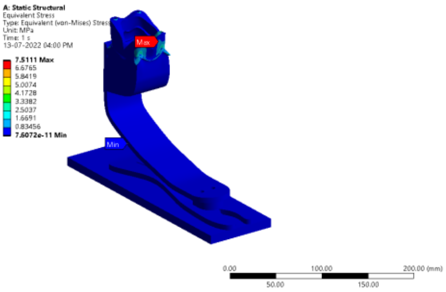

Figure 216: Equivalent Stress

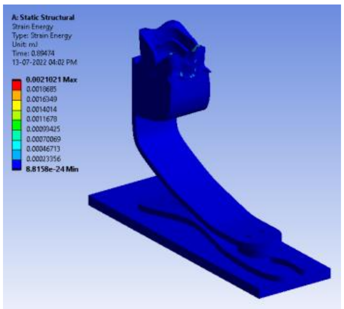

Figure 217: Strain Energy

B) ABS+ PC Plastic

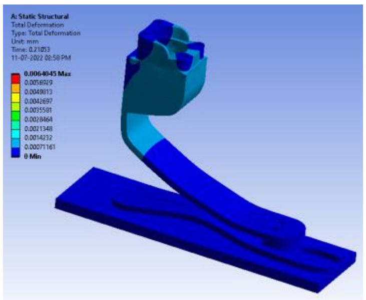

Figure 218: Total deformation (mm)

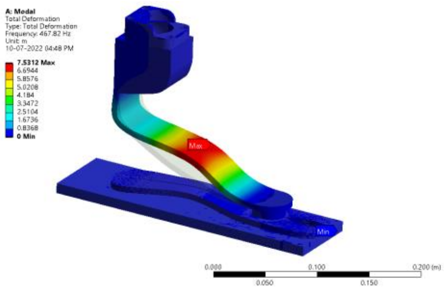

Figure 219: Total deformation (Hz)

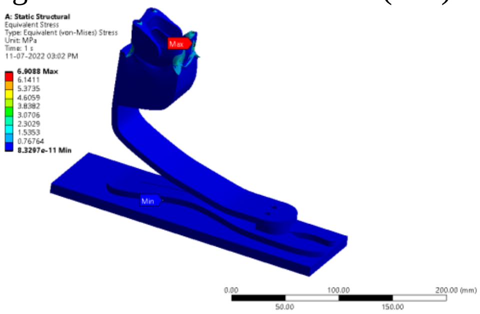

Figure 220: Equivalent Stress

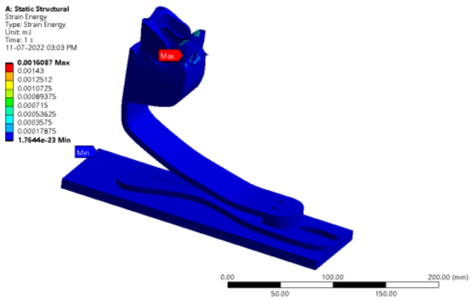

Figure 221: Strain Energy

C) ACETAL RESIN

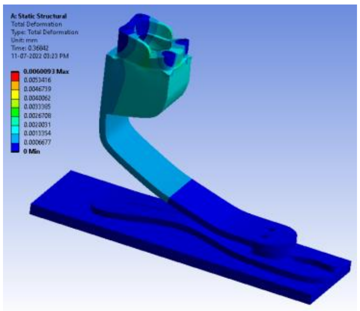

Figure 222: Total deformation (mm)

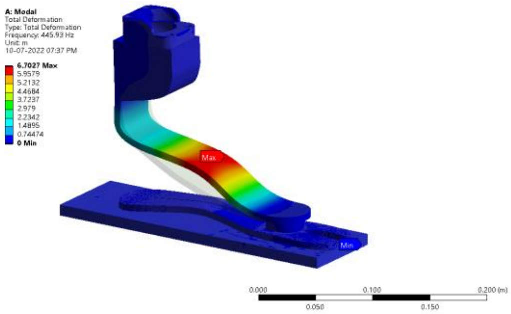

Figure 223: Total deformation (Hz)

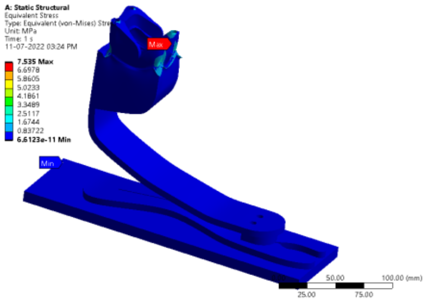

Figure 224: Equivalent Stress

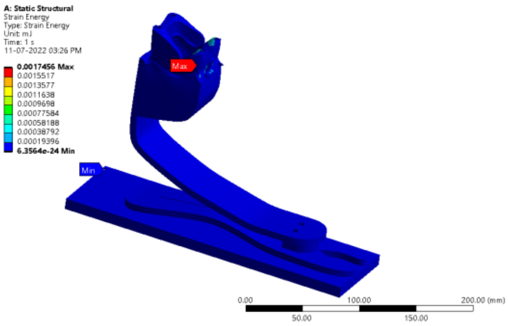

Figure 225: Strain Energy

D) CFRC

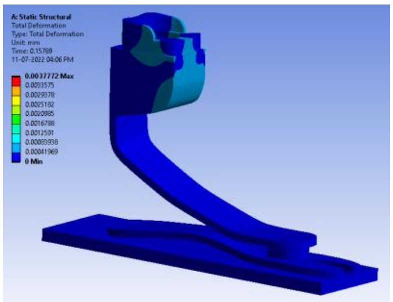

Figure 226: Total deformation (mm)

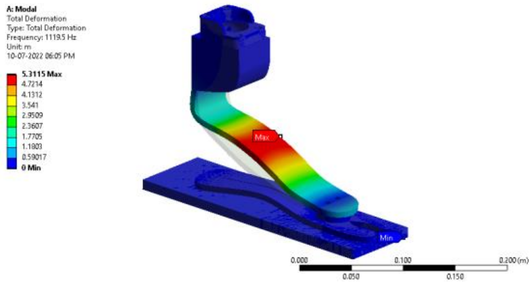

Figure 227: Total deformation (Hz)

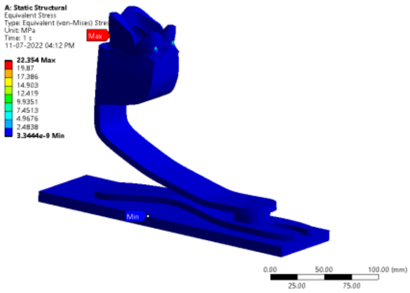

Figure 228: Equivalent Stress

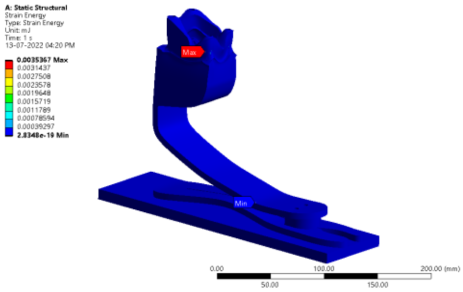

Figure 229: Strain Energy

E) NYLON 6/6

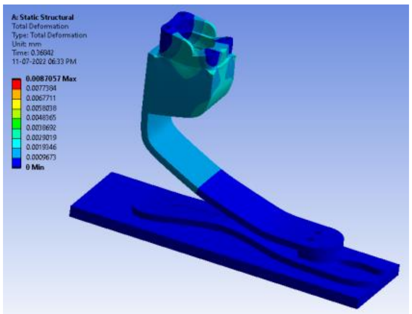

Figure 230: Total deformation (mm)

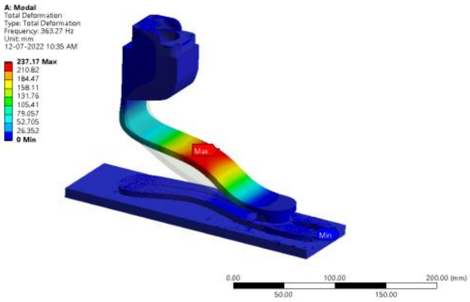

Figure 231: Total deformation (Hz)

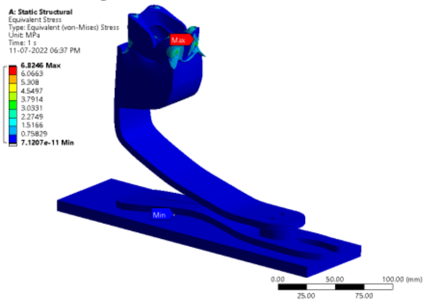

Figure 232: Equivalent Stress

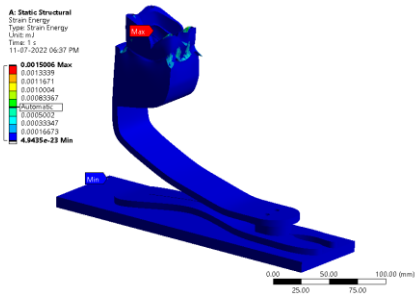

Figure 233: Strain Energy

F) PEEK

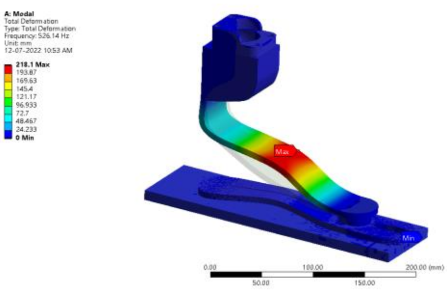

Figure 234: Total deformation (Hz)

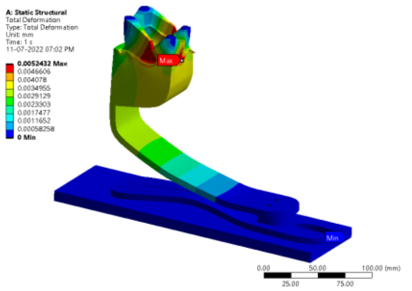

Figure 235: Total deformation (mm)

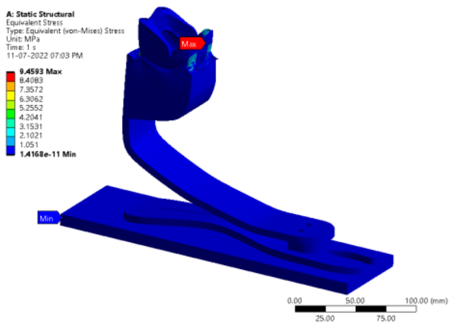

Figure 236: Equivalent Stress

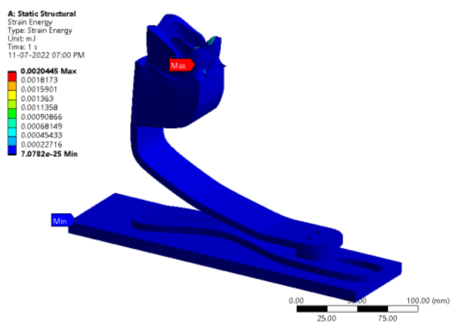

Figure 237: Strain Energy

G) PET

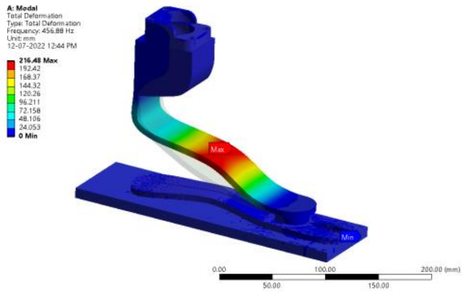

Figure 238: Total deformation (Hz)

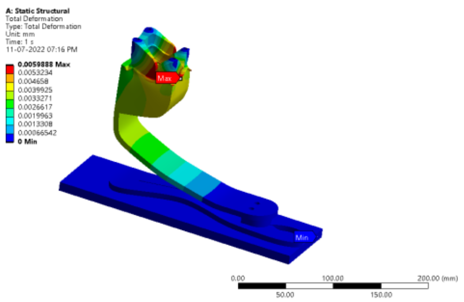

Figure 239: Total deformation (mm)

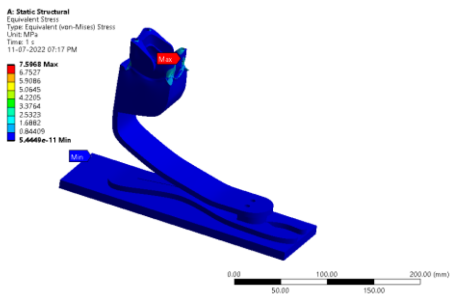

Figure 240: Equivalent Stress

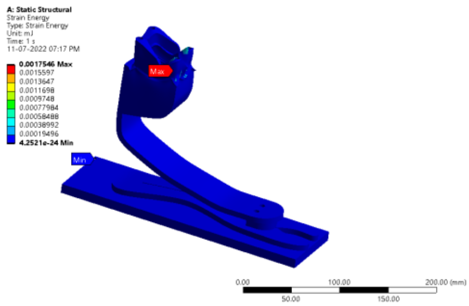

Figure 241: Strain Energy

H) PLA

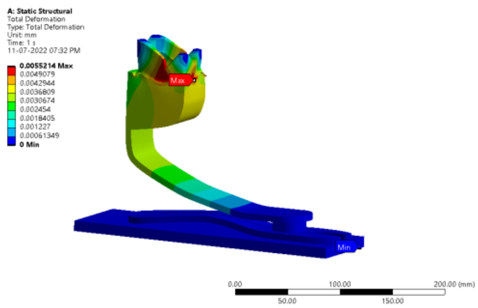

Figure 242: Total deformation (mm)

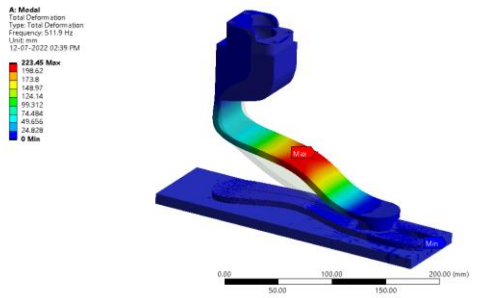

Figure 243: Total deformation (Hz)

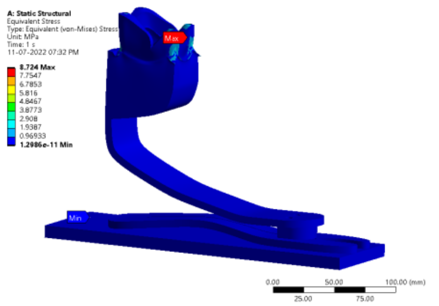

Figure 244: Equivalent Stress

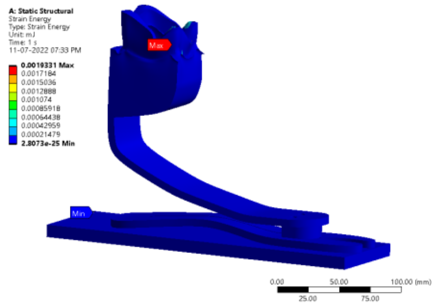

Figure 245: Strain Energy

I) UHMW-PE

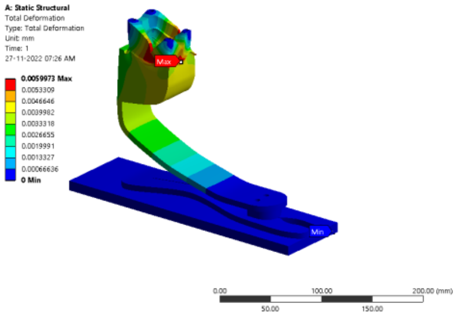

Figure 246: Total deformation (mm)

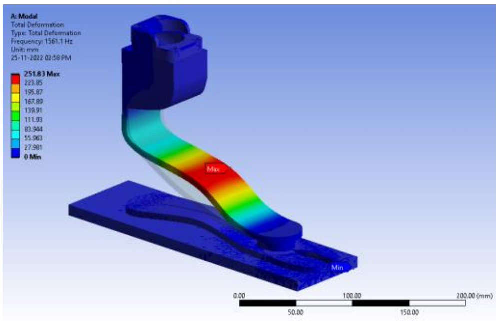

Figure 247: Total deformation (Hz)

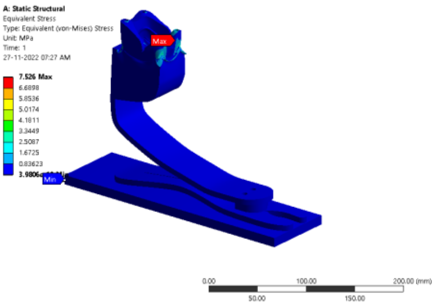

Figure 248: Equivalent Stress

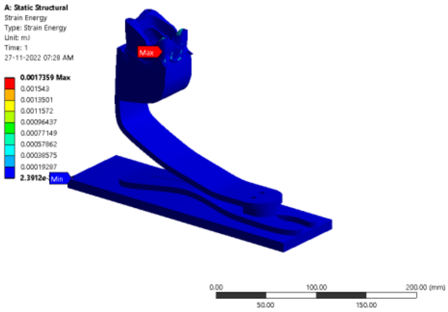

Figure 249: Strain Energy

Prosthetic Foot Model 5

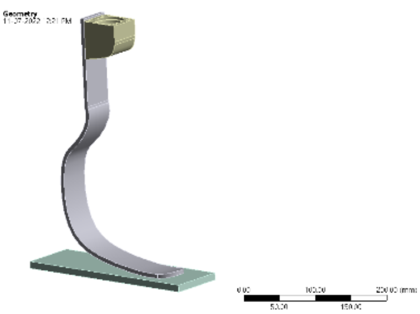

Figure 250: Prosthetic foot geometry

Figure 251: Mesh model

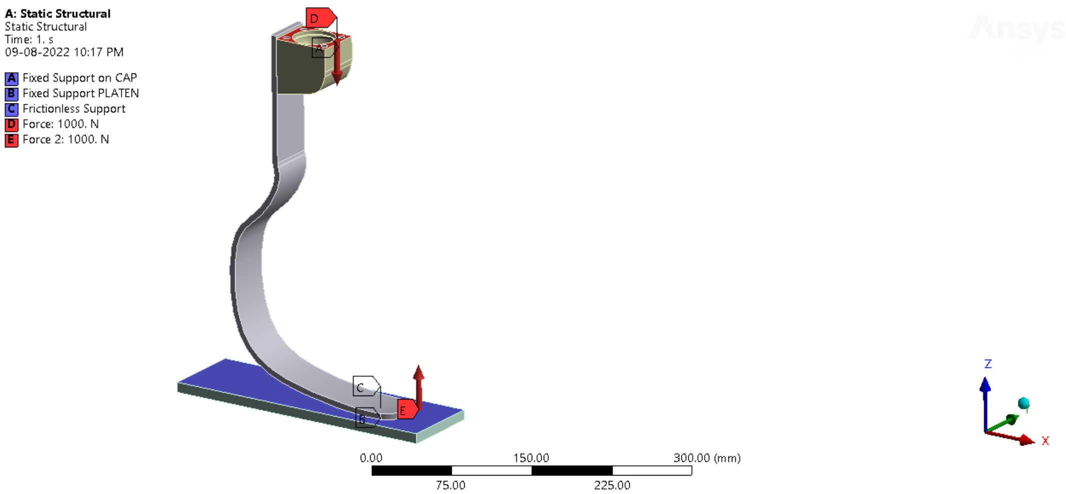

Figure 252: Static structural simulation

Table 7: Midstance analysis on prosthetic foot model 5

Sr no.	Materials	Prosthetic Foot Model 5			
		Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	ABS	115.35	0.011	4.0724	0.001078
2	ABS+PC PLASTIC	114.33	0.01109	4.0724	0.001077
3	ACETAL RESIN	108.76	0.011099	4.0721	0.001076
4	CFRC	168	0.0111	4.0705	0.001065
5	NYLON 6/6	87.363	0.01109	4.0732	0.00108
6	PEEK	129.57	0.011102	4.0716	0.001074
7	PET	111.43	0.01109	4.0721	0.001076
8	PLA	125.53	0.0111	4.0718	0.001075
9	UHMW-PE	351.9	0.011119	4.075	0.001066

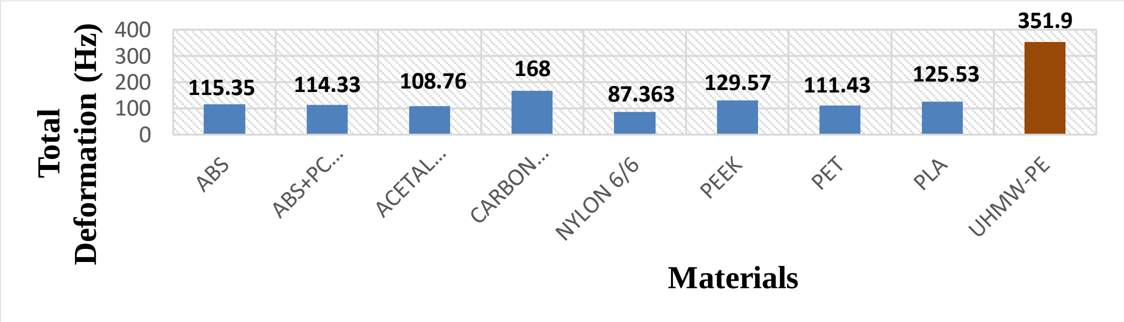

Figure 253: Total deformation in Hz for Prosthetic foot model 1 during mid-stance analysis

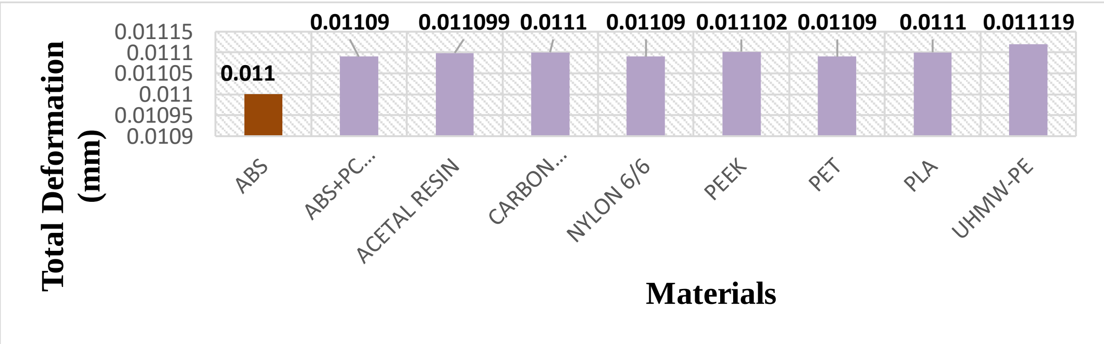

Figure 254: Total deformation in mm for Prosthetic foot model 1 during mid-stance analysis

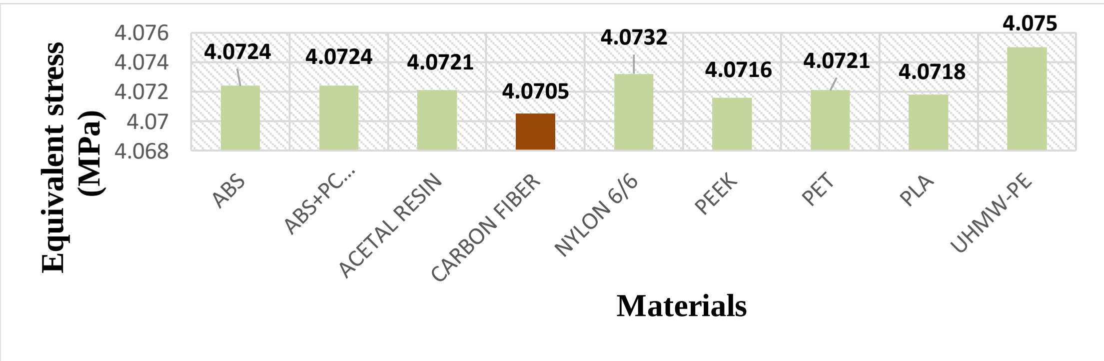

Figure 255: Equivalent stress for Prosthetic foot model 1 during mid-stance analysis

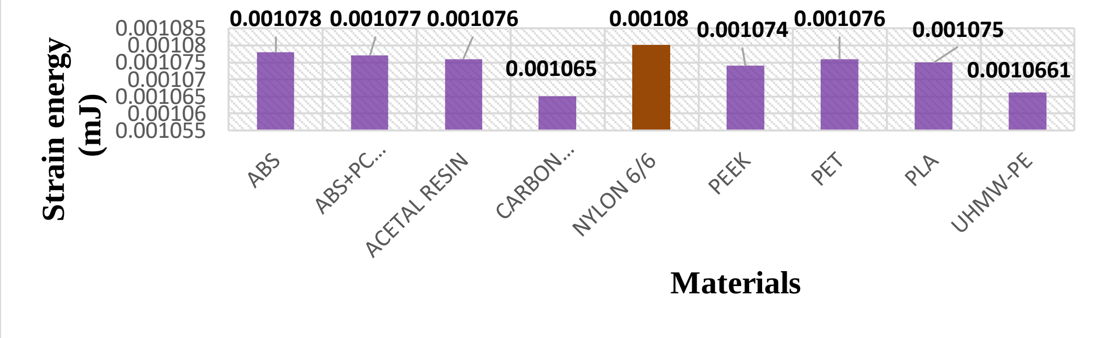

Figure 256: Strain energy for Prosthetic foot model 1 during mid-stance analysis

A) ABS

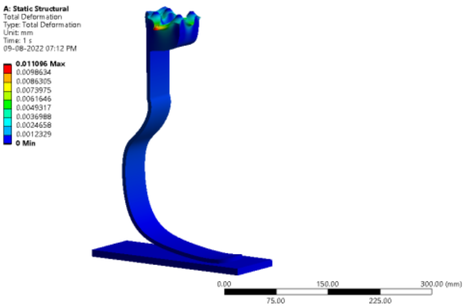

Figure 257: Total deformation (mm)

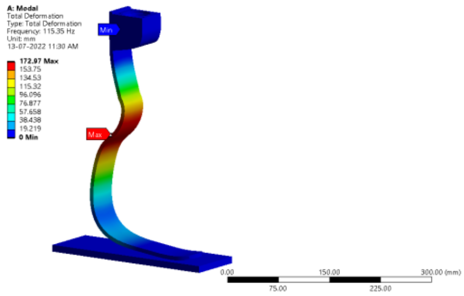

Figure 258: Total deformation (Hz)

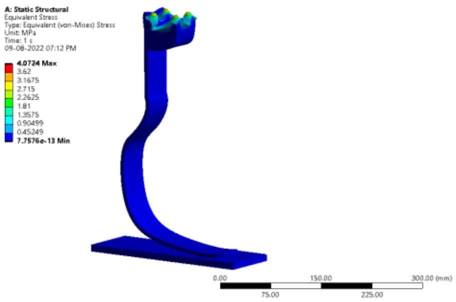

Figure 259: Equivalent Stress

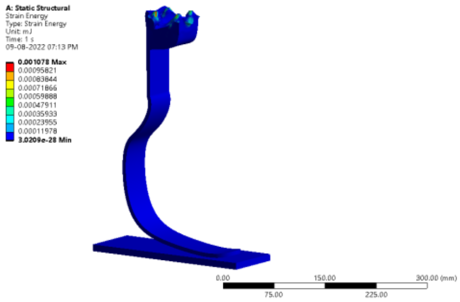

Figure 260: Strain Energy

B) ABS+ PC Plastic

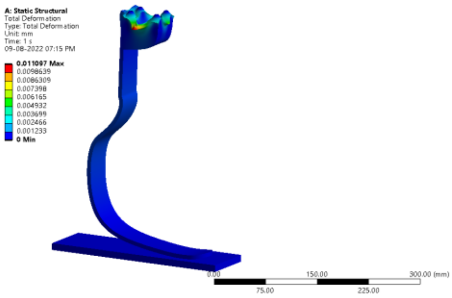

Figure 261: Total deformation (mm)

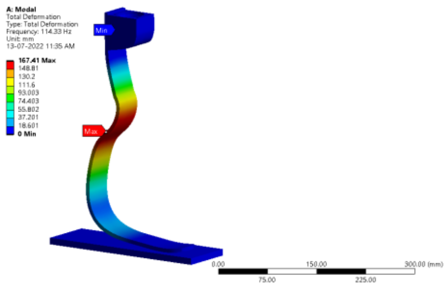

Figure 262: Total deformation (Hz)

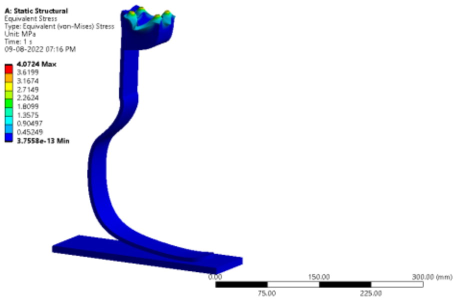

Figure 263: Equivalent Stress

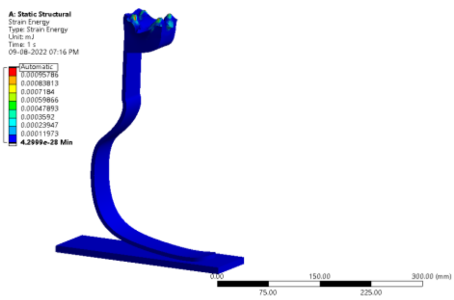

Figure 264: Strain Energy

C) ACETAL RESIN

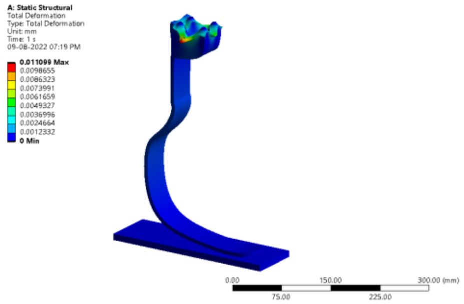

Figure 265: Total deformation (mm)

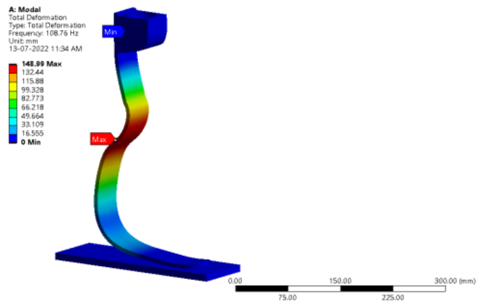

Figure 266: Total deformation (Hz)

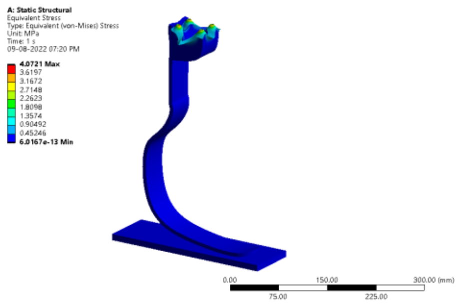

Figure 267: Equivalent Stress

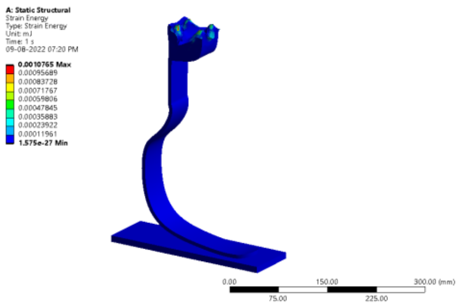

Figure 268: Strain Energy

D) CFRC

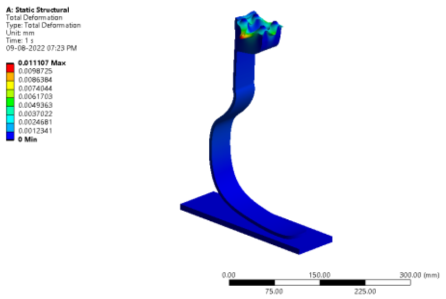

Figure 269: Total deformation (mm)

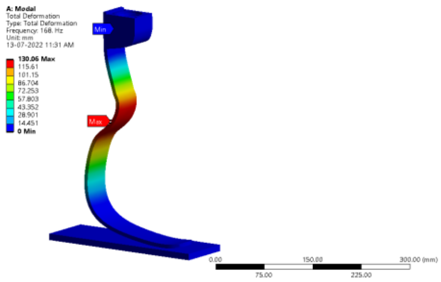

Figure 270: Total deformation (Hz)

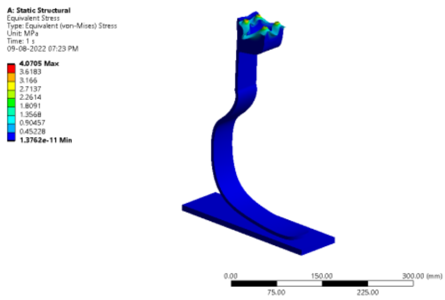

Figure 271: Equivalent Stress

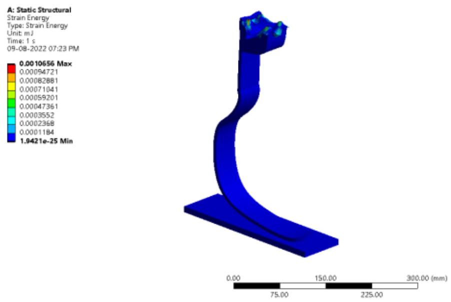

Figure 272: Strain Energy

E) NYLON 6/6

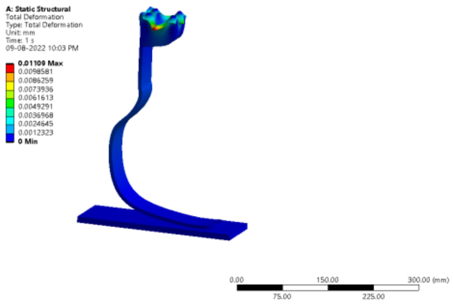

Figure 273: Total deformation (mm)

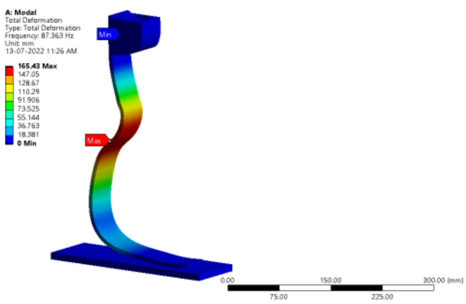

Figure 274: Total deformation (Hz)

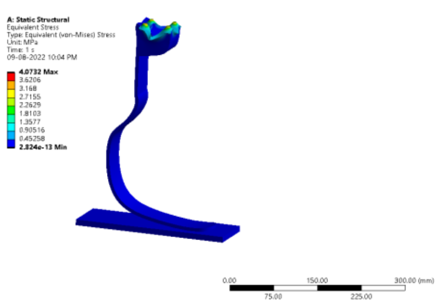

Figure 275: Equivalent Stress

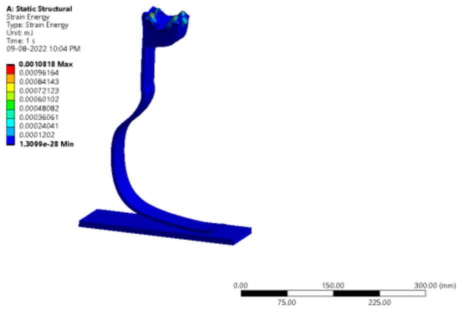

Figure 276: Strain Energy

F) PEEK

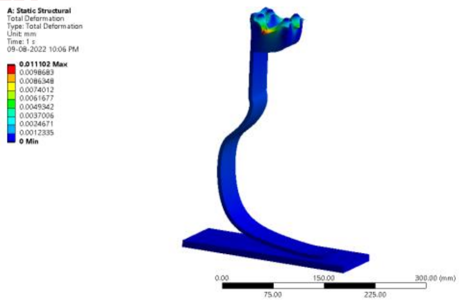

Figure 277: Total deformation (mm)

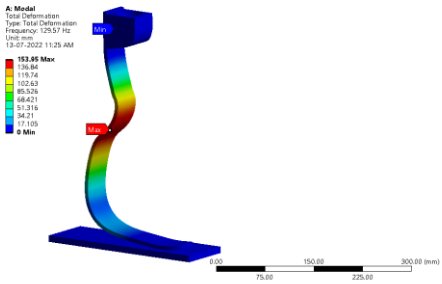

Figure 278: Total deformation (Hz)

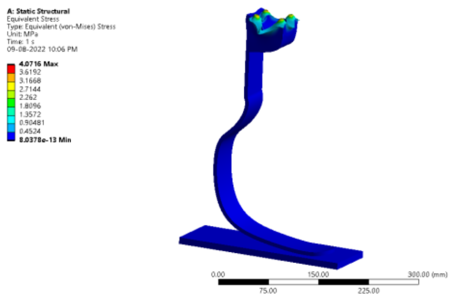

Figure 279: Equivalent Stress

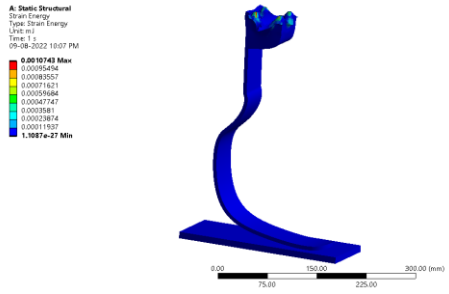

Figure 280: Strain Energy

G) PET

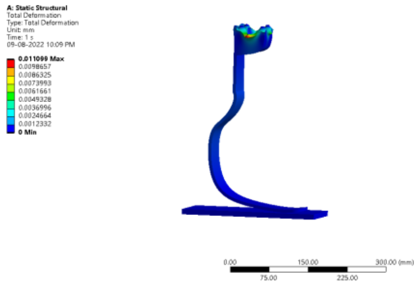

Figure 281: Total deformation (mm)

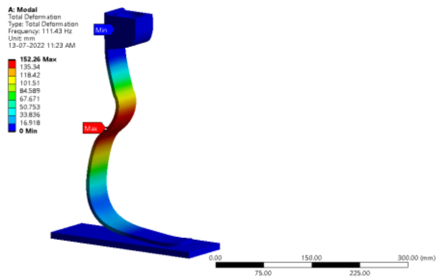

Figure 282: Total deformation (Hz)

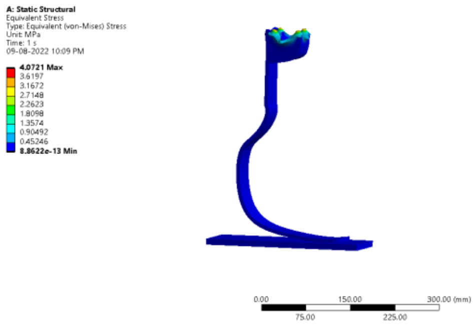

Figure 283: Equivalent Stress

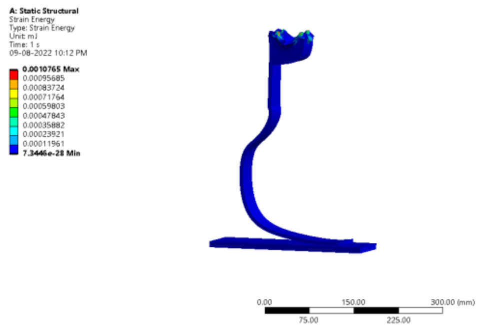

Figure 284: Strain Energy

H) PLA

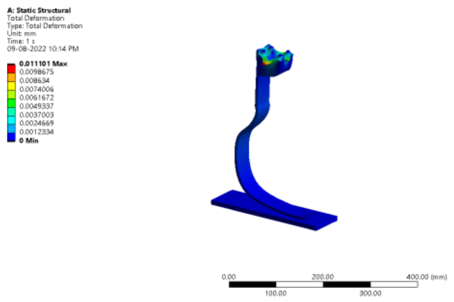

Figure 285: Total deformation (mm)

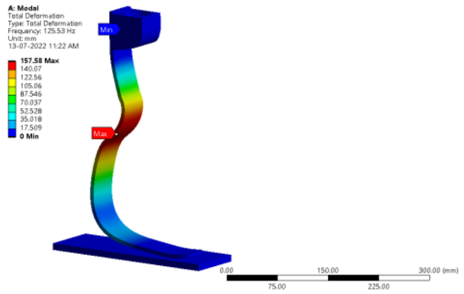

Figure 286: Total deformation (Hz)

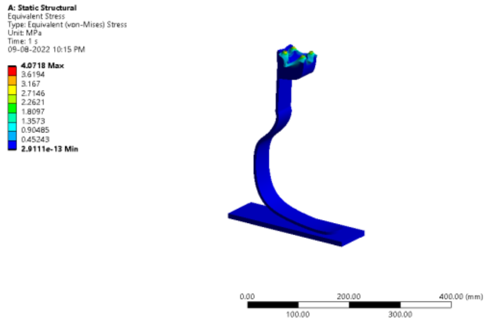

Figure 287: Equivalent Stress

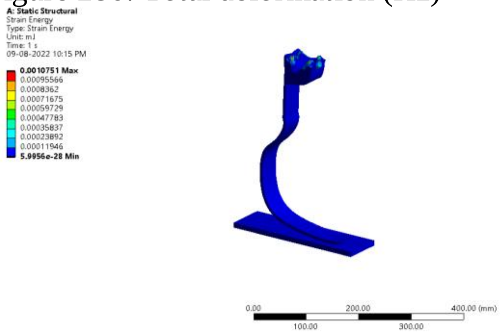

Figure 288: Strain Energy

I) UHMW-PE

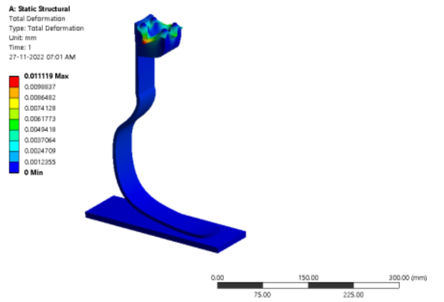

Figure 289: Total deformation (mm)

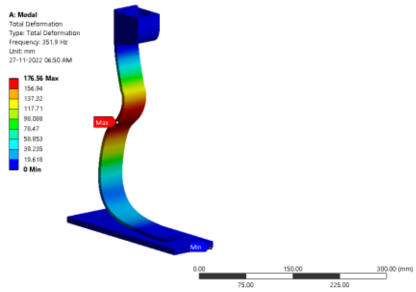

Figure 290: Total deformation (Hz)

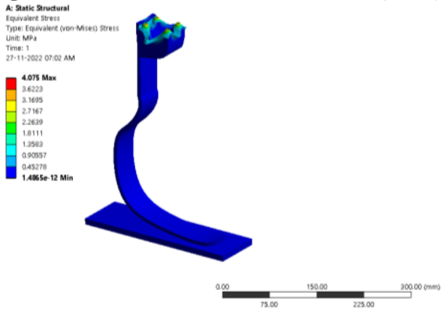

Figure 291: Equivalent Stress

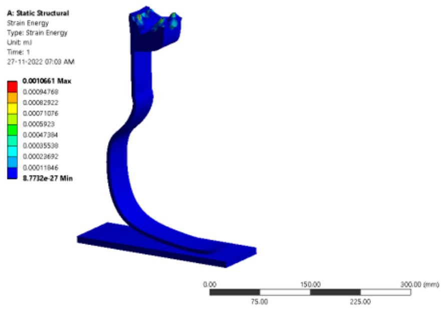

Figure 292: Strain Energy

Prosthetic Foot Model 6

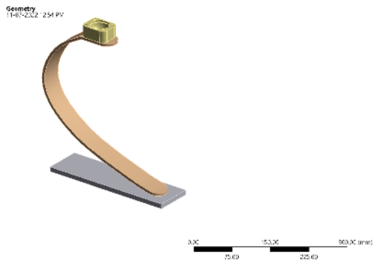

Figure 293: Prosthetic foot geometry

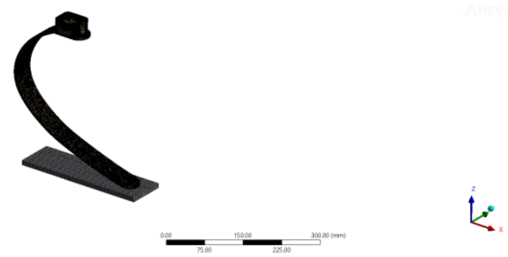

Figure 294: Mesh model

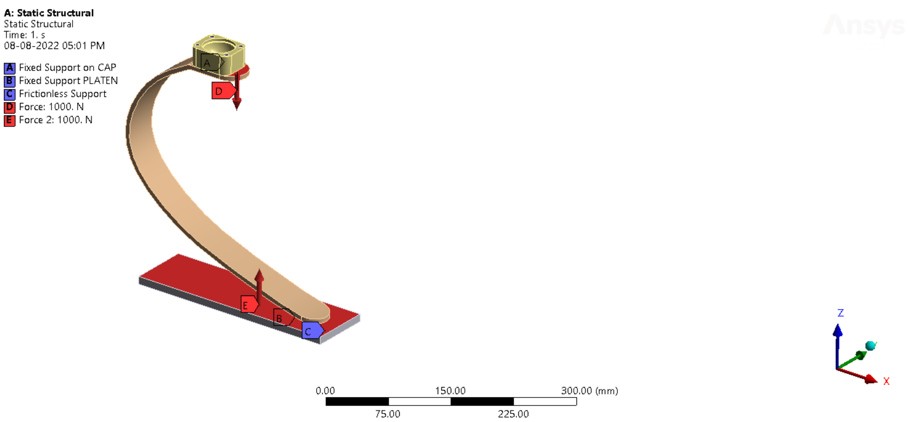

Figure 295: Static structural simulation

Table 8: Midstance analysis on prosthetic foot model 6

Sr no.	Materials	Prosthetic Foot Model 6			
		Total deformation (Hz)	Total deformation (mm)	Equivalent stress (MPa)	Strain energy (mJ)
1	ABS	71.674	0.061478	7.9646	0.007344
2	ABS+PC PLASTIC	71.076	0.05909	7.8205	0.007229
3	ACETAL RESIN	67.725	0.05297	7.4223	0.006896
4	CFRC	165.25	0.006786	18.127	0.002922
5	NYLON 6/6	54.022	0.091491	9.5511	0.011318
6	PEEK	80.869	0.04215	6.5367	0.0062
7	PET	69.432	0.052739	7.4208	0.006861
8	PLA	78.347	0.045984	6.8977	0.00645
9	UHME-PE	208.71	0.010744	16.968	0.002732

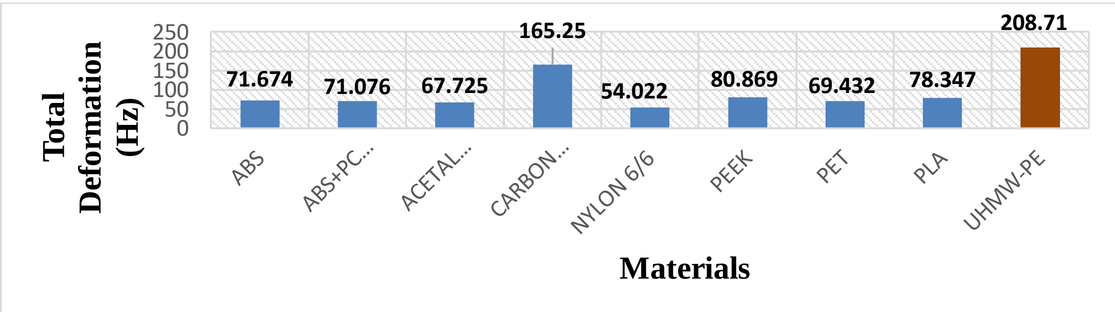

Figure 296: Total deformation in Hz for Prosthetic foot model 1 during mid-stance analysis

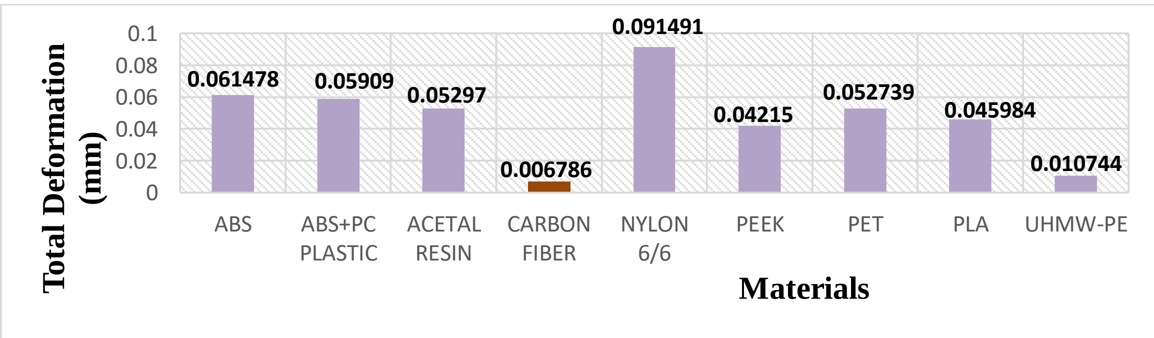

Figure 297: Total deformation in mm for Prosthetic foot model 1 during mid-stance analysis

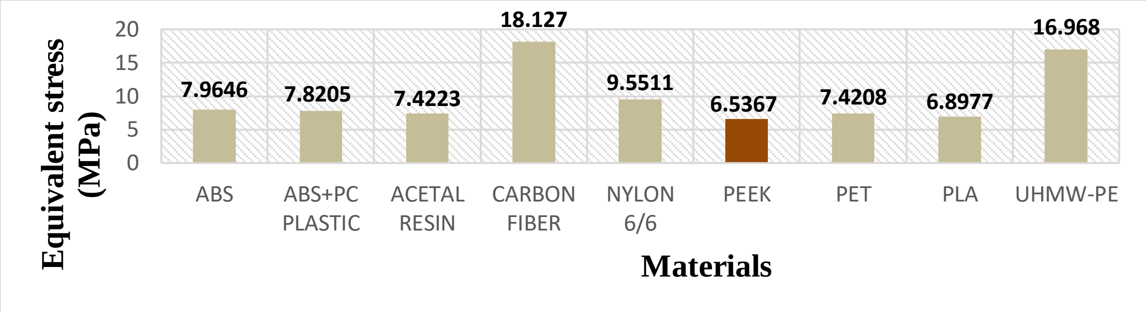

Figure 298: Equivalent stress for Prosthetic foot model 1 during mid-stance analysis

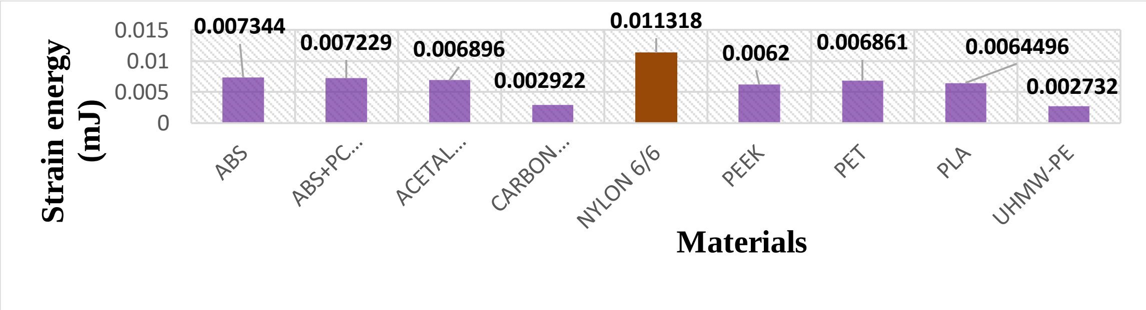

Figure 299: Strain energy for Prosthetic foot model 1 during mid-stance analysis

A) ABS

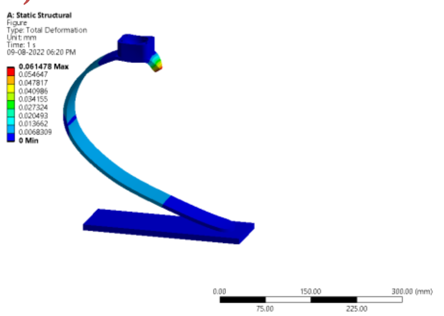

Figure 300: Total deformation (mm)

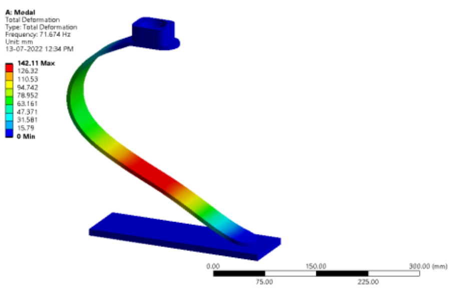

Figure 301: Total deformation (Hz)

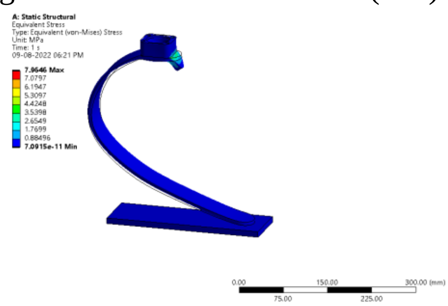

Figure 302: Equivalent Stress

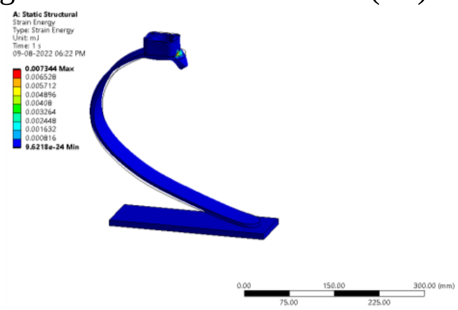

Figure 303: Strain Energy

B) ABS+ PC Plastic

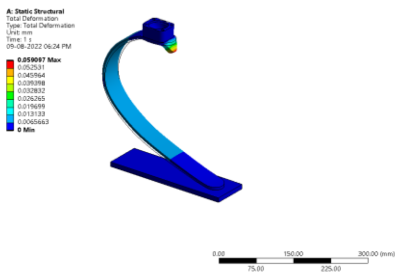

Figure 304: Total deformation (mm)

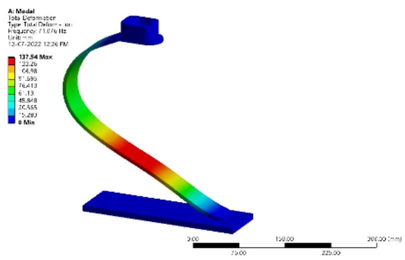

Figure 305: Total deformation (Hz)

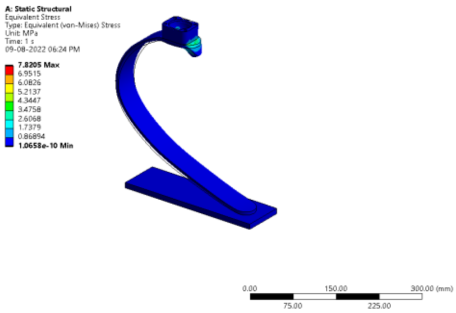

Figure 306: Equivalent Stress

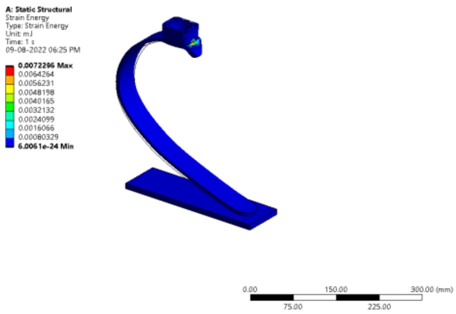

Figure 307: Strain Energy

C) ACETAL RESIN

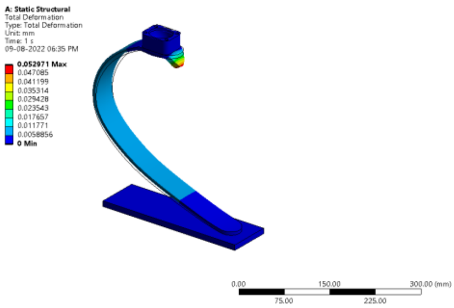

Figure 308: Total deformation (mm)

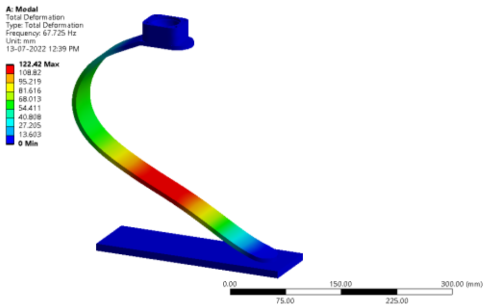

Figure 309: Total deformation (Hz)

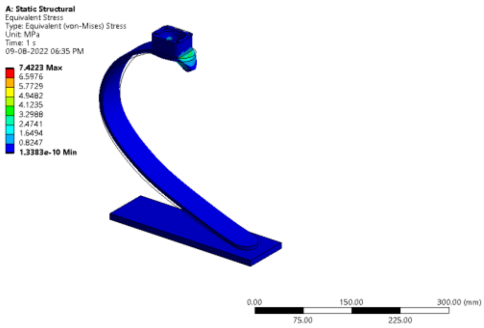

Figure 310: Equivalent Stress

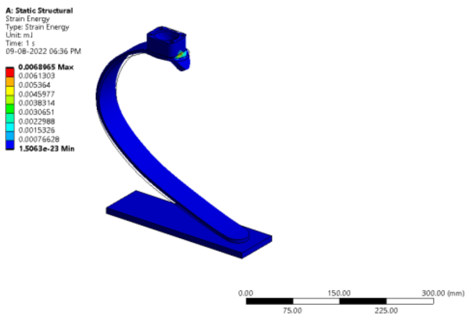

Figure 311: Strain Energy

D) CFRC

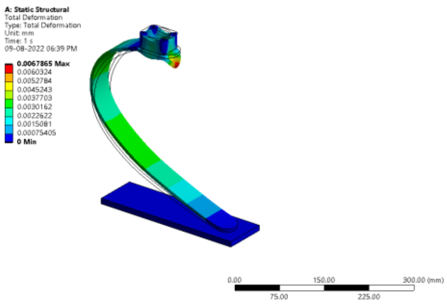

Figure 312: Total deformation (mm)

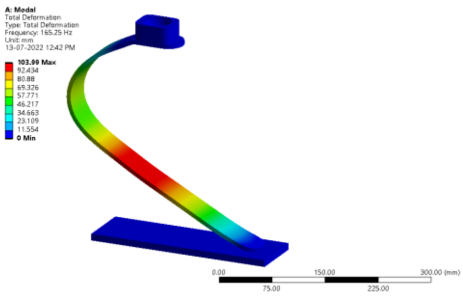

Figure 313: Total deformation (Hz)

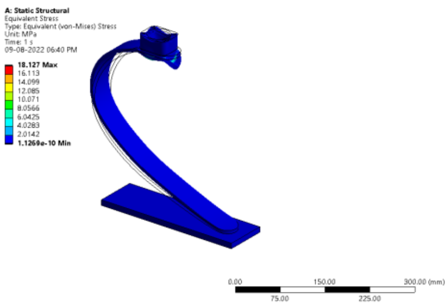

Figure 314: Equivalent Stress

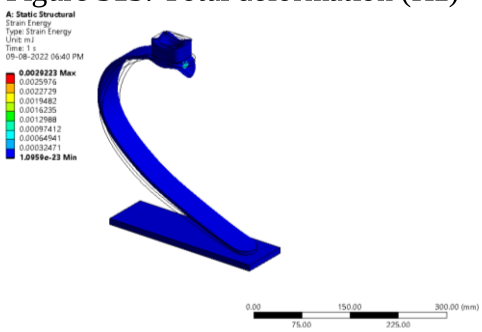

Figure 315: Strain Energy

E) NYLON 6/6

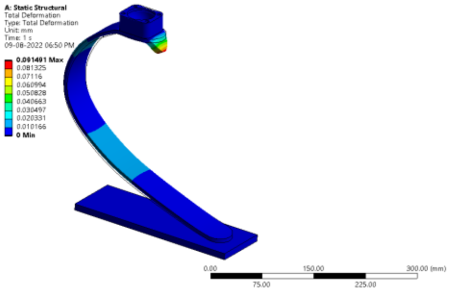

Figure 316: Total deformation (mm)

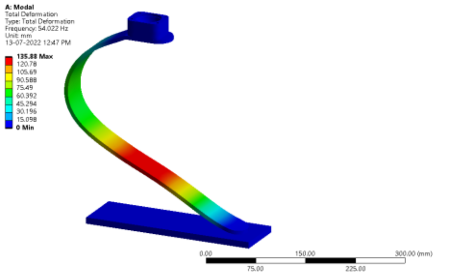

Figure 317: Total deformation (Hz)

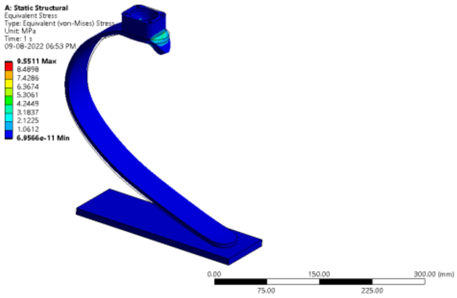

Figure 318: Equivalent Stress

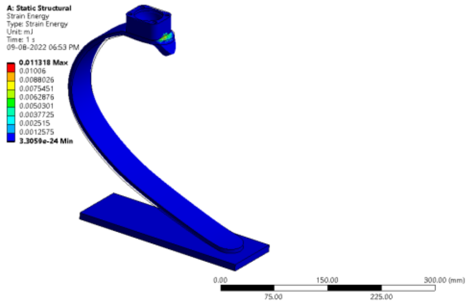

Figure 319: Strain Energy

F) PEEK

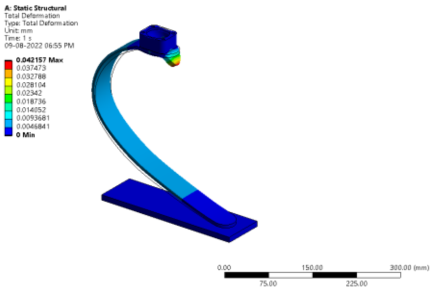

Figure 320: Total deformation (mm)

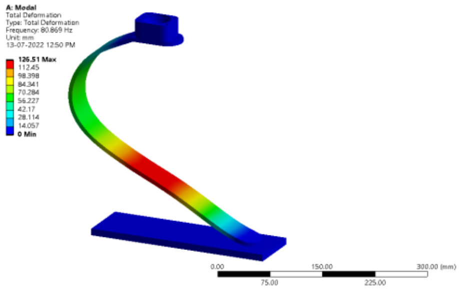

Figure 321: Total deformation (Hz)

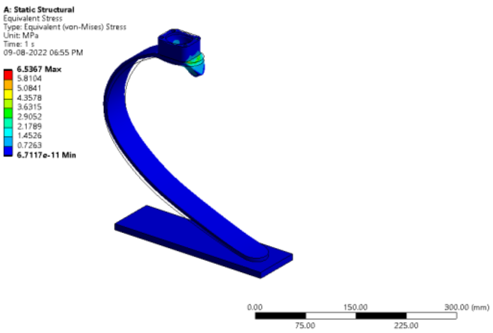

Figure 322: Equivalent Stress

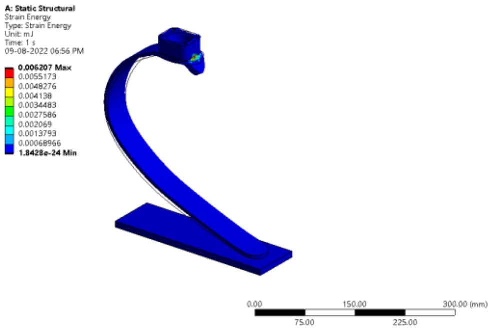

Figure 323: Strain Energy

G) PET

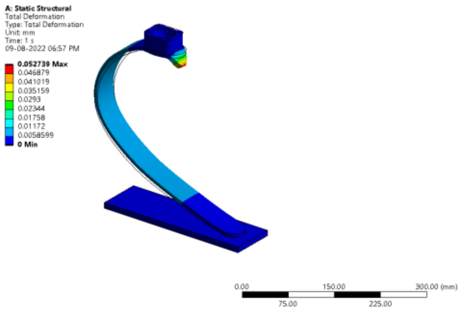

Figure 324: Total deformation (mm)

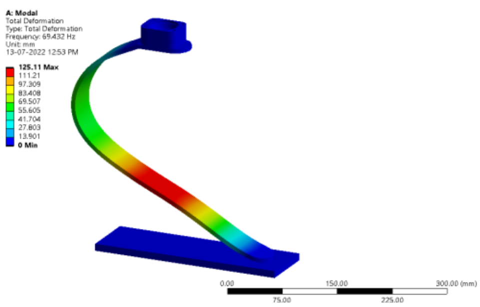

Figure 325: Total deformation (Hz)

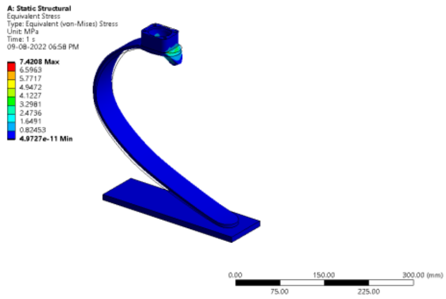

Figure 326: Equivalent Stress

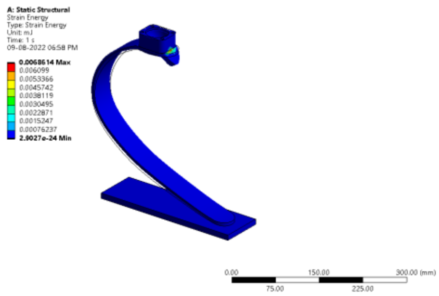

Figure 327: Strain Energy

H) PLA

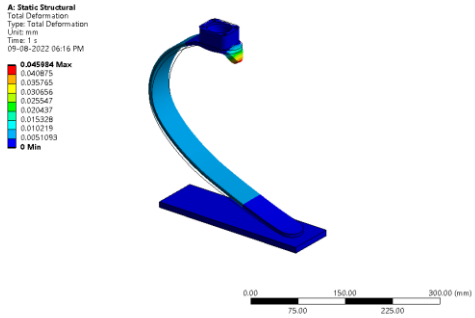

Figure 328: Total deformation (mm)

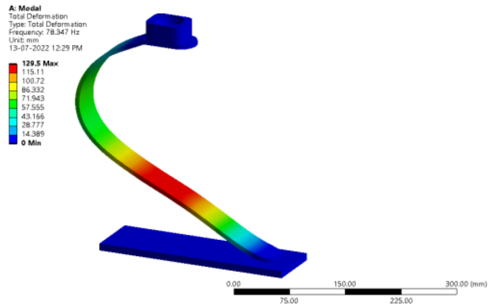

Figure 329: Total deformation (Hz)

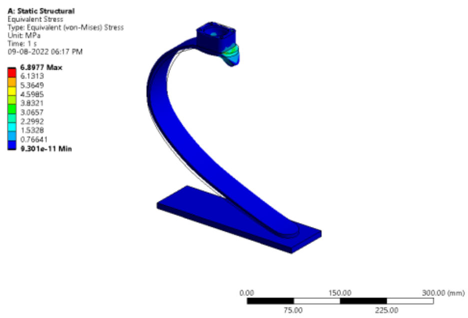

Figure 330: Equivalent Stress

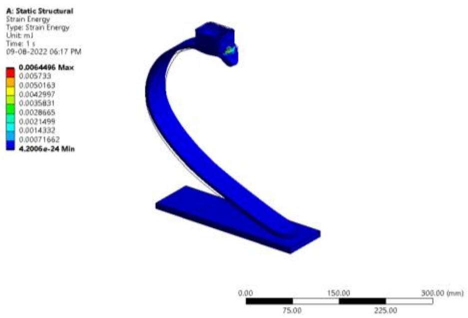

Figure 331: Strain Energy

I) UHMW-PE

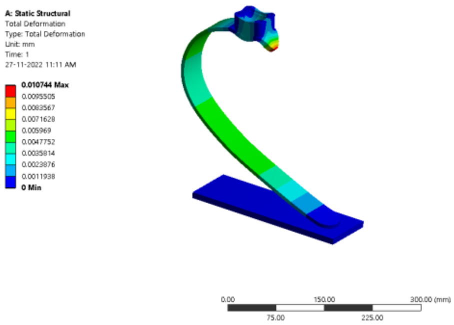

Figure 332: Total deformation (mm)

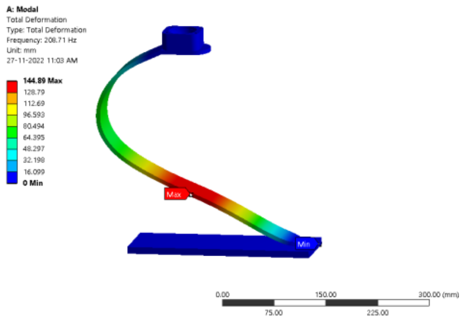

Figure 333: Total deformation (Hz)

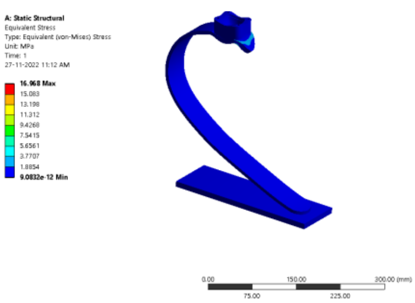

Figure 334: Equivalent Stress

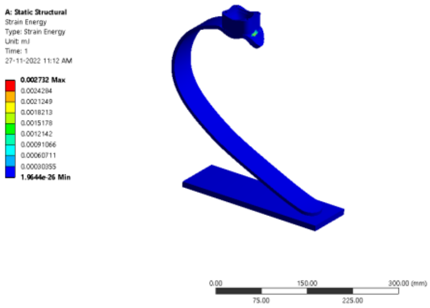

Figure 335: Strain Energy

APPENDIX-D

CP WALKER MATERIAL ANALYSIS DATA

Table 1. CP walker material analysis data (Child weight)

Sr no.	B Group Parts (Frame, Seat, Collar) Material list	Child weight							
		20 kg				40 kg			
		Sitting position		Standing position		Sitting position		Standing position	
		Total deformation (mm)	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*
A1	**S.S**	0.02798	6.1617	0.037296	2.3656	0.05596	12.323	0.074591	4.7312
A2	**Aluminum**	0.07229	5.5124	0.10083	2.3561	0.14458	11.025	0.20166	4.7123
A3	**Titanium**	0.05428	5.7266	0.74509	2.3445	0.10857	11.453	0.14902	4.6891
A4	**CFRC**	0.5816	8.6493	1.1105	4.1447	1.1623	17.299	2.2211	8.2893
A5	**PEEK**	1.2068	10.831	1.8379	3.6804	2.4136	21.662	3.6757	7.3607
A6	**PLA**	1.3439	11.141	2.052	3.7806	2.6877	22.282	4.1039	7.5612
A7	**PET**	1.5905	11.63	2.4422	3.9087	3.181	23.26	4.8844	7.8174
A8	**Acetal Resin (POM)**	1.6002	11.657	2.4565	3.9242	3.2004	23.314	4.913	7.8484
A9	**ABS+PC Plastic**	1.8276	12.031	2.8184	4.0178	3.6552	24.061	5.6369	8.0356
A10	**Nylon 6/6**	3.0493	13.274	4.7707	4.3559	6.0985	26.547	9.5415	8.7118

A1. Child weight: 20 Kg (Material: S.S.)

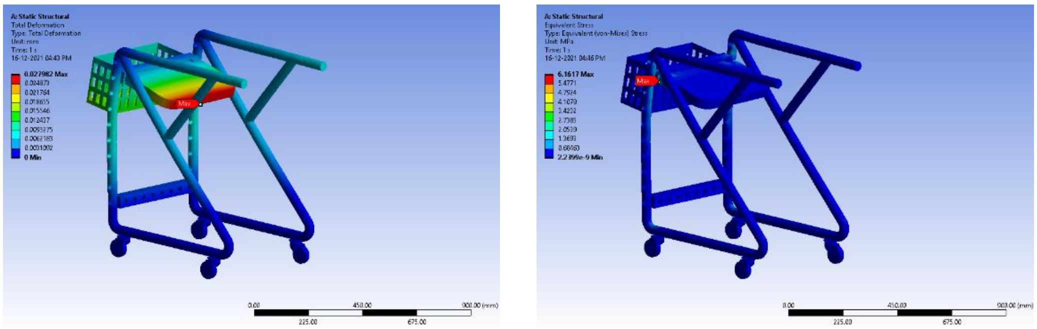

Fig. 1. Total deformation and Equivalent stress for weight of child as 20 kg in a sitting position (S.S. Material)

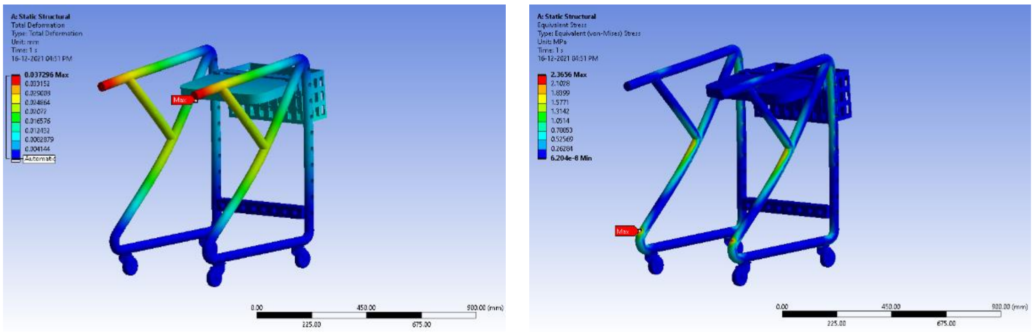

Fig. 2. Total deformation and Equivalent stress for weight of child as 20 kg in standing position (S.S. Material)

A1. Child weight: 40 Kg (Material: S.S.)

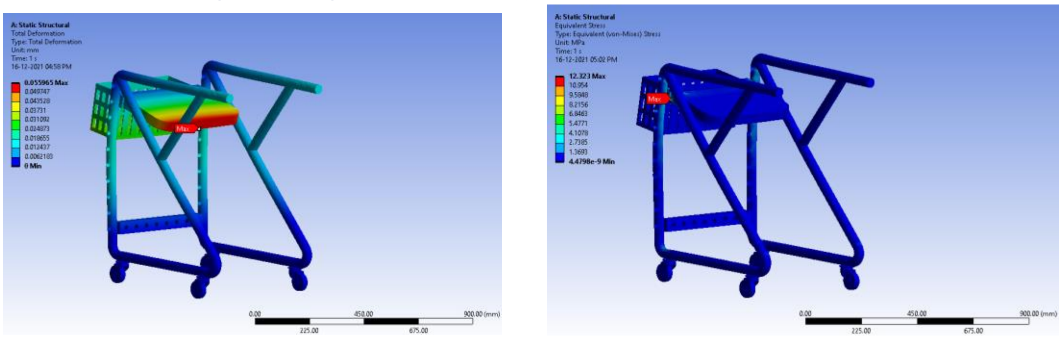

Fig. 3. Total deformation and Equivalent stress for weight of child as 40 kg in a sitting position (S.S. Material)

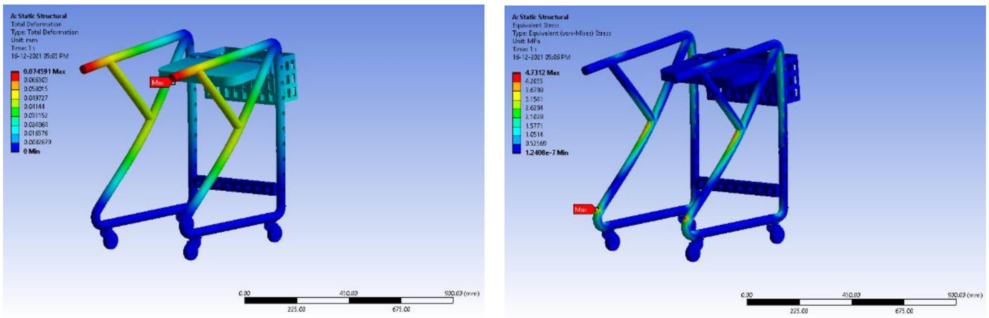

Fig. 4. Total deformation and Equivalent stress for weight of child as 40 kg in standing position (S.S. Material)

A2. Child weight: 20 Kg (Material: Al.)

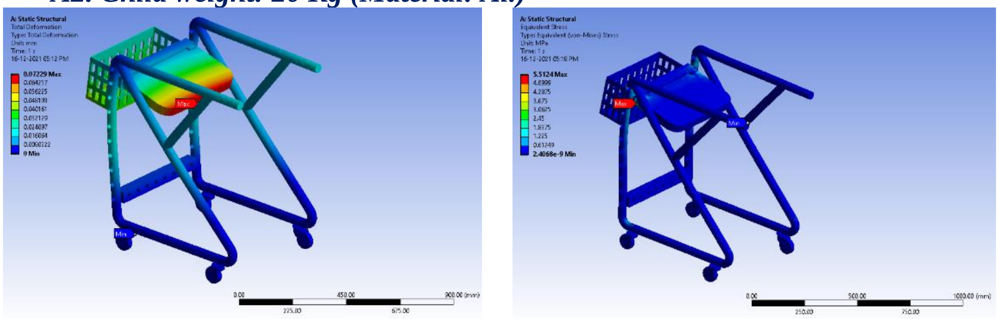

Fig. 5. Total deformation and Equivalent stress for weight of child as 20 kg in a sitting position (Al. Material)

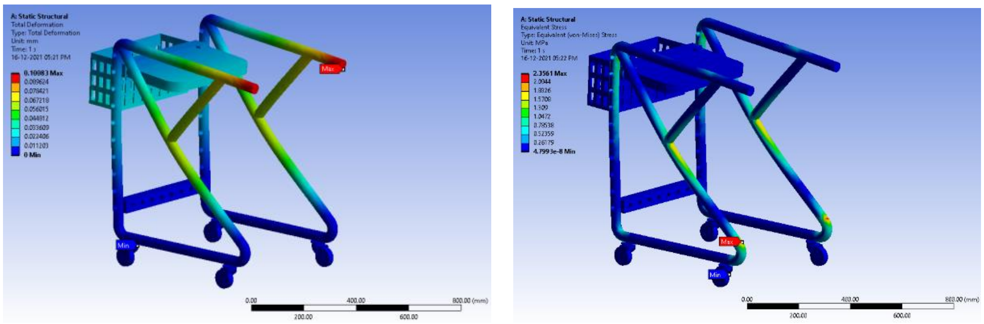

Fig. 6. Total deformation and Equivalent stress for weight of child as 20 kg in standing position (Al. Material)

A2. Child weight: 40 Kg (Material: Al.)

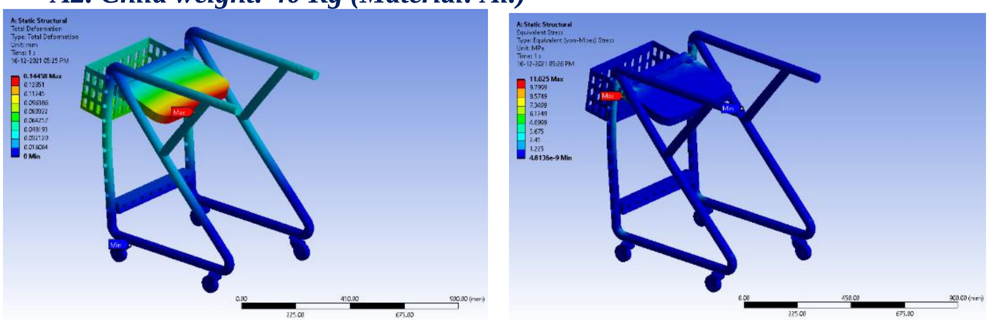

Fig. 7. Total deformation and Equivalent stress for weight of child as 40 kg in a sitting position (Al. Material)

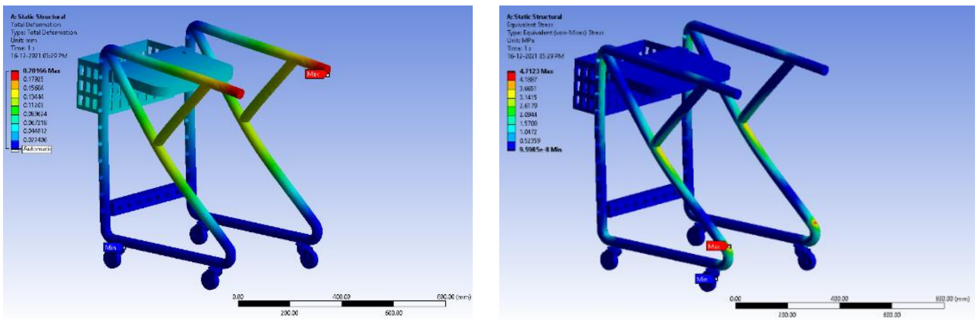

Fig. 8. Total deformation and Equivalent stress for weight of child as 40 kg in standing position (Al. Material)

A3. Child weight: 20 Kg (Material: Ti.)

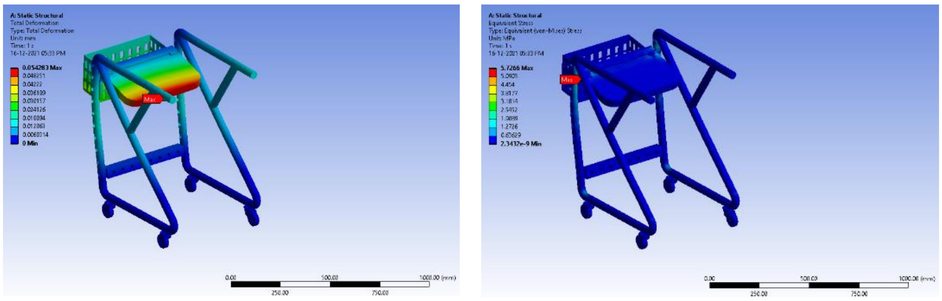

Fig. 9. Total deformation and Equivalent stress for weight of child as 20 kg in a sitting position (Ti. Material)

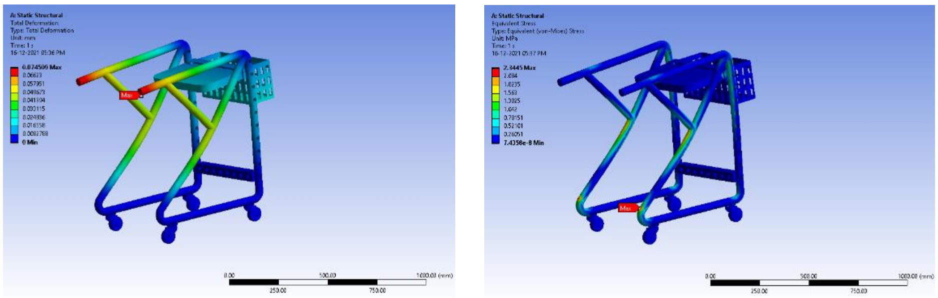

Fig. 10. Total deformation and Equivalent stress for weight of child as 20 kg in standing position (Ti. Material)

A3. Child weight: 40 Kg (Material: Ti.)

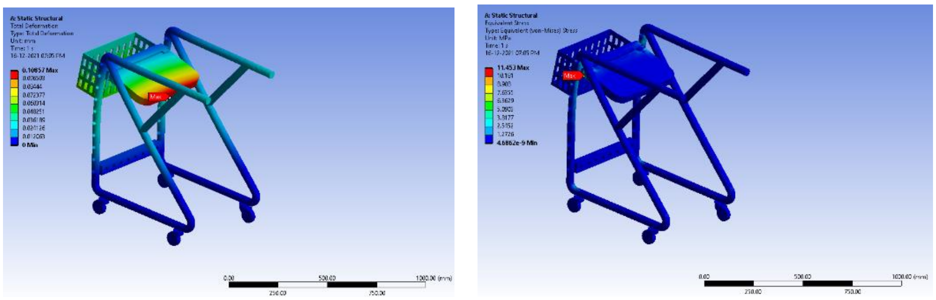

Fig. 11. Total deformation and Equivalent stress for weight of child as 40 kg in a sitting position (Ti. Material)

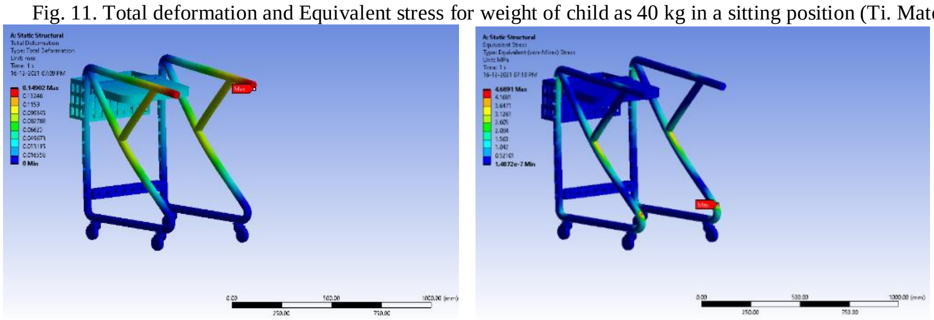

Fig. 12. Total deformation and Equivalent stress for weight of child as 40 kg in standing position (Ti. Material)

A4. Child weight: 20 Kg (Material: CFRC)

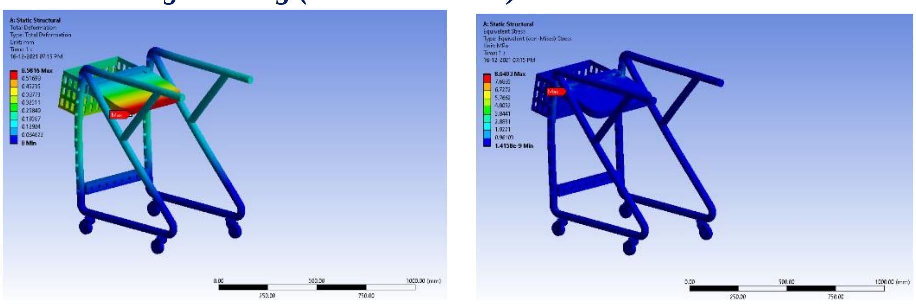

Fig. 13. Total deformation and Equivalent stress for weight of child as 20 kg in a sitting position (Carbon fiber Composite Material)

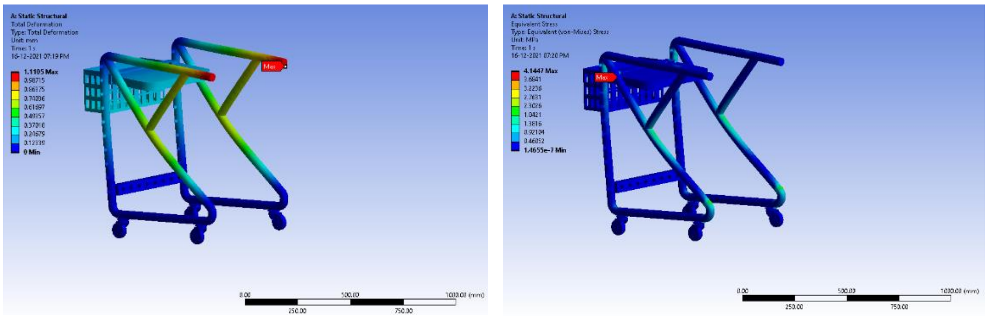

Fig. 14. Total deformation and Equivalent stress for weight of child as 20 kg in standing position (Carbon fiber Composite Material)

A4. Child weight: 40 Kg (Material: CFRC)

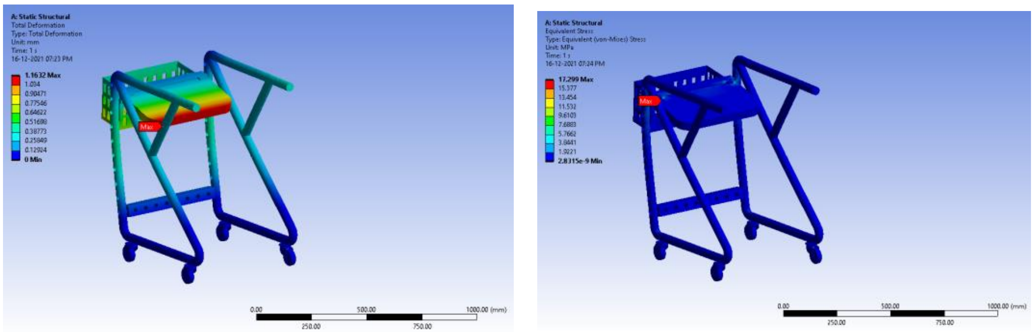

Fig. 15. Total deformation and Equivalent stress for weight of child as 40 kg in a sitting position (Carbon fiber Composite Material)

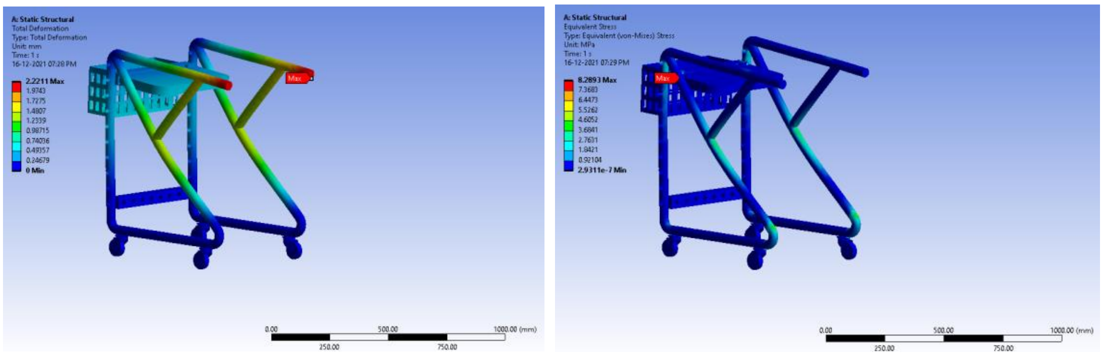

Fig. 16. Total deformation and Equivalent stress for weight of child as 40 kg in standing position (Carbon fiber Material)

Table 2. CP walker material analysis data (Adult weight)

Sr no.	B Group Parts (Frame, Seat, Collar) Material list	Adult weight							
		50 kg				100 kg			
		Sitting position		Standing position		Sitting position		Standing position	
		Total deformation (mm)	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*	*Total deformation (mm)*	*Equivalent stress (MPa)*
B1	**S.S**	0.06995	15.404	0.093239	5.914	0.13991	30.808	0.18648	11.828
B2	**Aluminum**	0.18072	13.781	0.25207	5.8904	0.36145	27.562	0.50414	11.781
B3	**Titanium**	0.13571	14.316	0.18627	5.8614	0.27141	28.633	0.3725	11.723
B4	**CFRC**	1.454	21.623	2.7764	10.362	2.908	43.247	5.5527	20.723
B5	**PEEK**	3.0169	27.078	4.5947	9.2009	6.0339	54.156	9.1893	18.402
B6	**PLA**	3.3596	27.853	5.1299	9.4515	6.7193	55.706	10.26	18.903
B7	**PET**	3.9763	29.075	6.1055	9.7717	7.9526	58.15	12.211	19.543
B8	**Acetal Resin (POM)**	4.0005	29.142	6.1413	9.8105	8.0009	58.285	12.283	19.621
B9	**ABS+PC Plastic**	4.5691	30.077	7.0461	10.045	9.1381	60.154	14.092	20.089
B10	**Nylon 6/6**	7.6232	33.184	11.927	10.89	15.246	66.368	23.854	21.78

B1. Adult weight: 50 Kg (Material: S.S.)

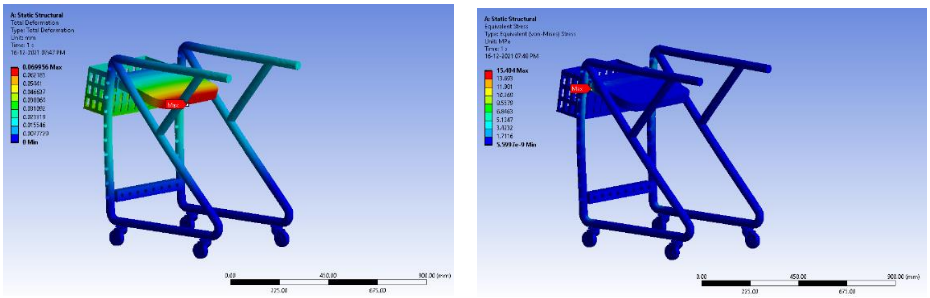

Fig. 17. Total deformation and Equivalent stress for weight of adult as 50 kg in a sitting position (S.S. Material)

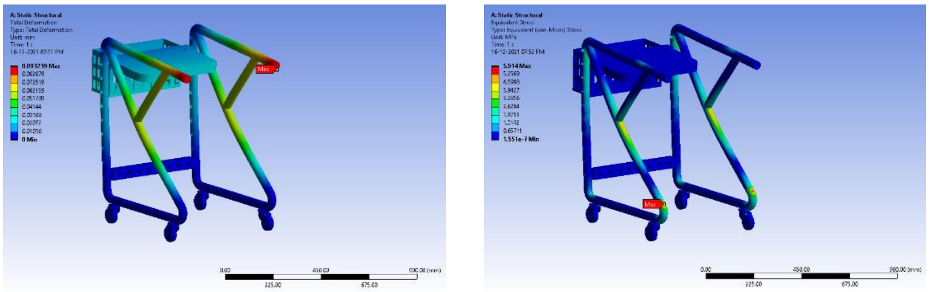

Fig. 18. Total deformation and Equivalent stress for weight of adult as 50 kg in standing position (S.S. Material)

B1. Adult weight: 100 Kg (Material: S.S.)

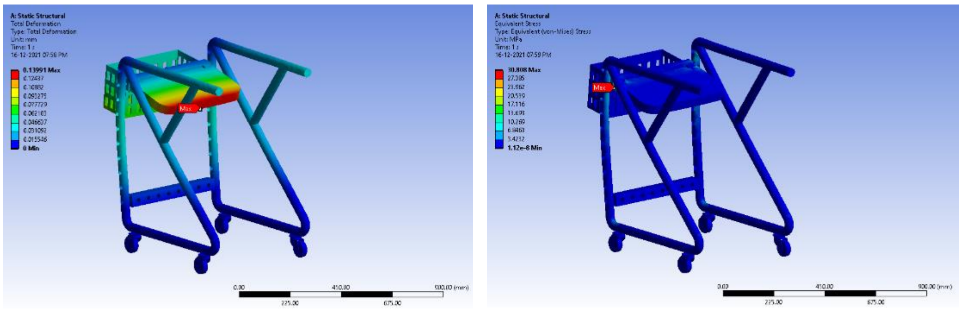

Fig. 19. Total deformation and Equivalent stress for weight of adult as 100 kg in a sitting position (S.S. Material)

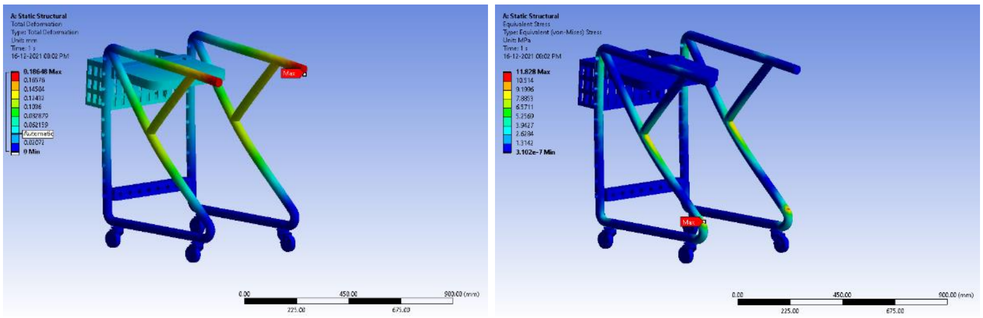

Fig. 20. Total deformation and Equivalent stress for weight of adult as 100 kg in standing position (S.S. Material)

B2. Adult weight: 50 Kg (Material: Al.)

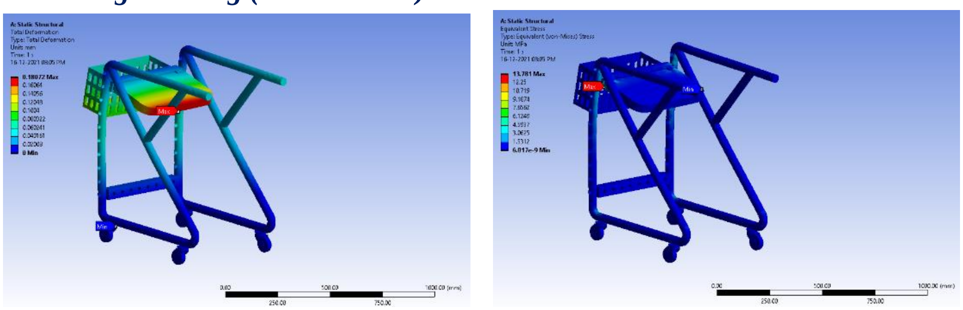

Fig. 21. Total deformation and Equivalent stress for weight of adult as 50 kg in a sitting position (Al. Material)

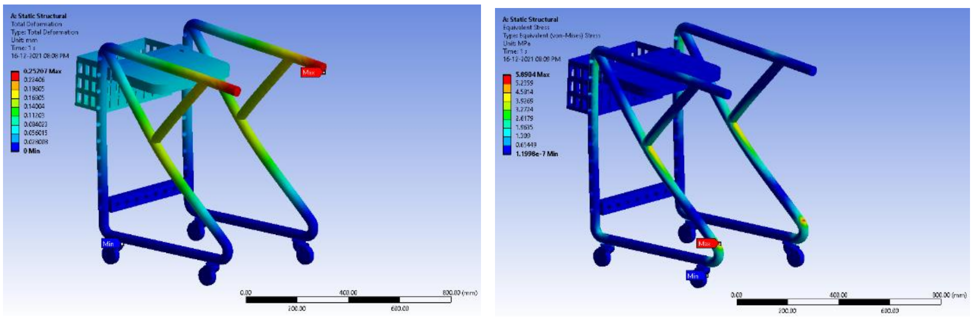

Fig. 22. Total deformation and Equivalent stress for weight of adult as 50 kg in standing position (Al. Material)

B2. Adult weight: 100 Kg (Material: Al.)

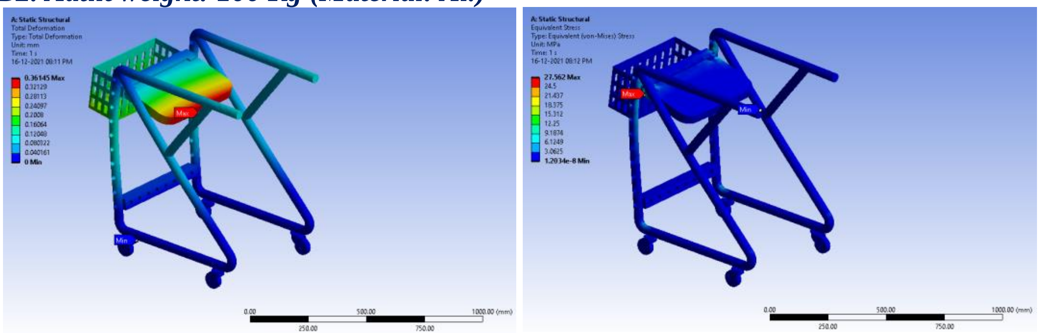

Fig. 23. Total deformation and Equivalent stress for weight of adult as 100 kg in a sitting position (Al. Material)

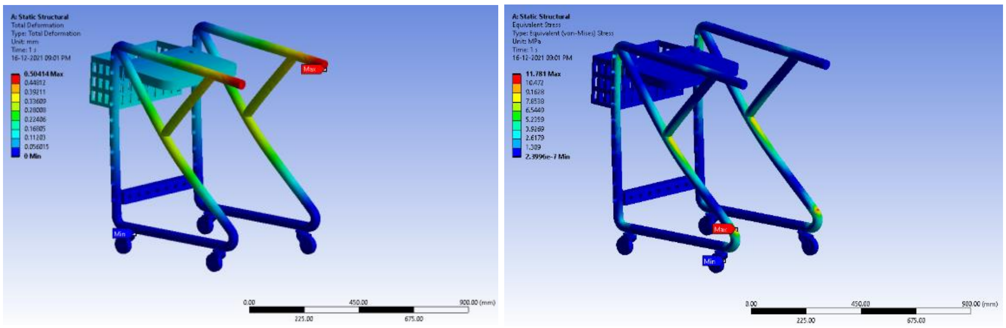

Fig. 24. Total deformation and Equivalent stress for weight of adult as 100 kg in standing position (Al. Material)

B3. Adult weight: 50 Kg (Material: Ti.)

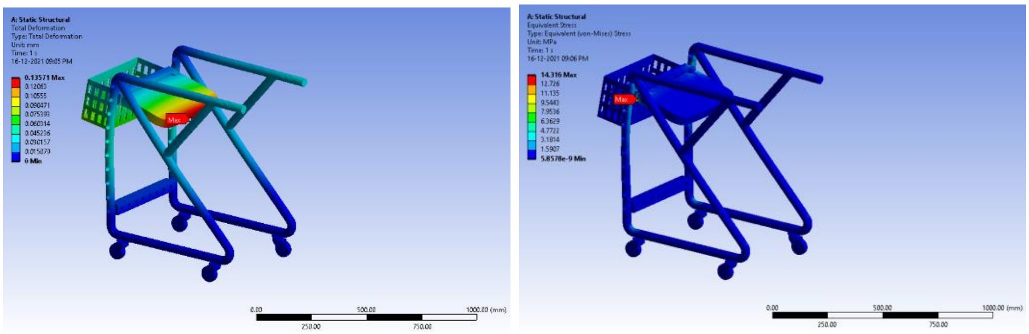

Fig. 25. Total deformation and Equivalent stress for weight of adult as 50 kg in a sitting position (Ti. Material)

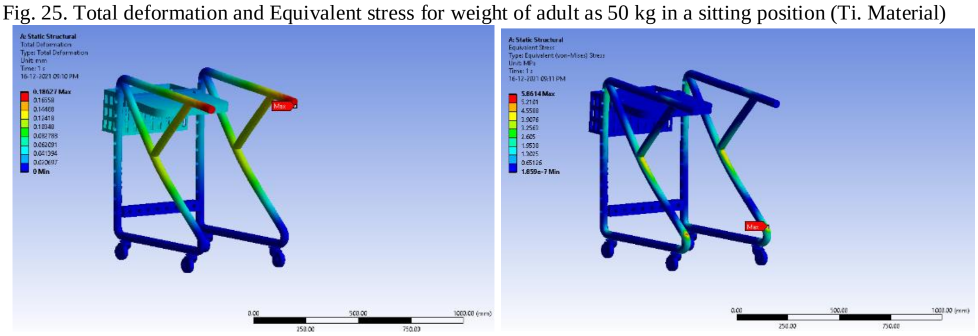

Fig. 26. Total deformation and Equivalent stress for weight of adult as 50 kg in standing position (Ti. Material)

B3. Adult weight: 100 Kg (Material: Ti.)

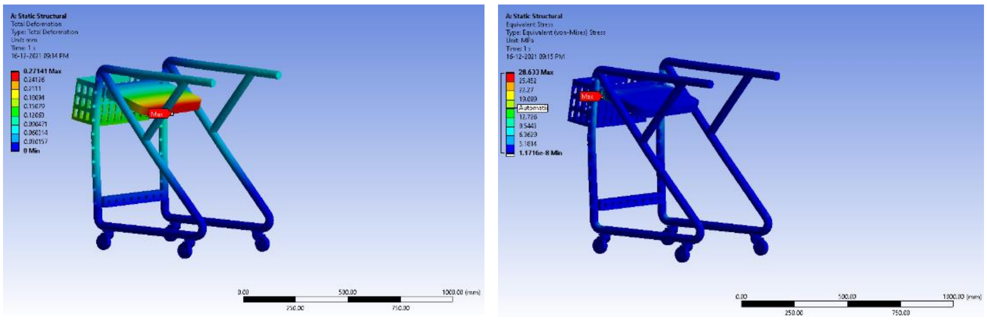

Fig. 27. Total deformation and Equivalent stress for weight of adult as 100 kg in a sitting position (Ti. Material)

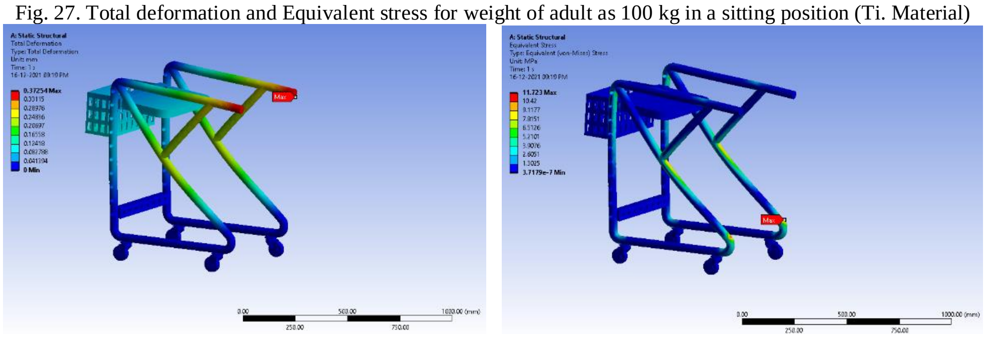

Fig. 28. Total deformation and Equivalent stress for weight of adult as 100 kg in standing position (Ti. Material)

B4. Adult weight: 50 Kg (Material: CFRC)

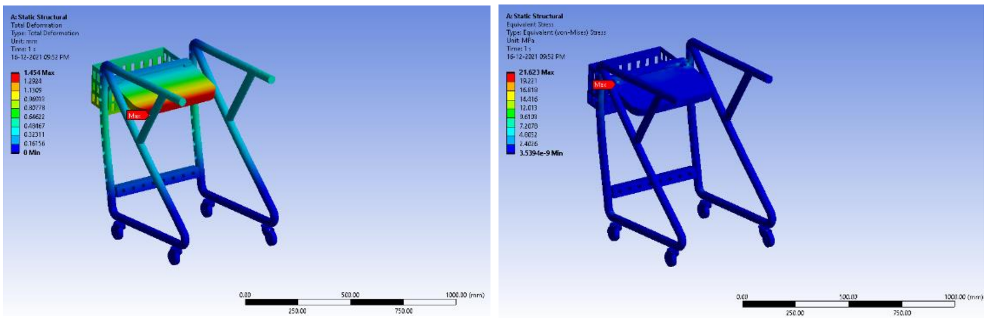

Fig. 29. Total deformation and Equivalent stress for weight of adult as 50 kg in a sitting position (Carbon fiber Composite Material)

Fig. 30. Total deformation and Equivalent stress for weight of adult as 50 kg in standing position (Carbon fiber Composite Material)

B4. Adult weight: 100 Kg (Material: CFRC)

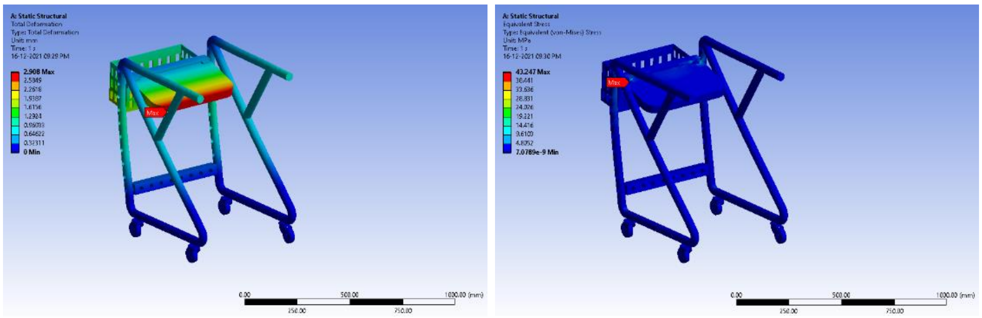

Fig. 31. Total deformation and Equivalent stress for weight of adult as 100 kg in a sitting position (Carbon fiber Composite Material)

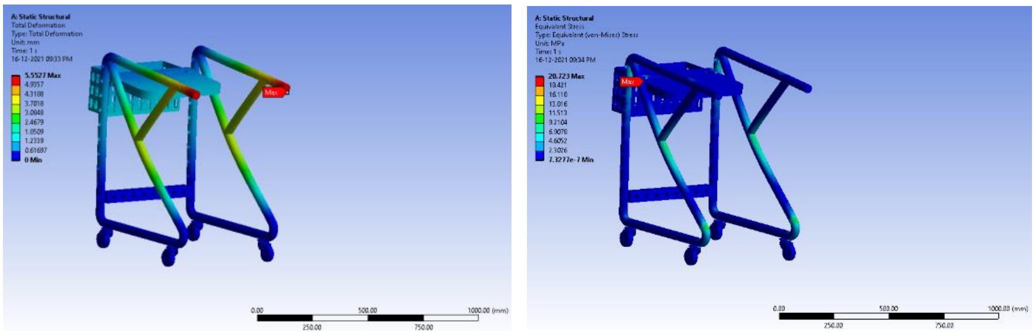

Fig. 32. Total deformation and Equivalent stress for weight of adult as 100 kg in standing position (Carbon fiber Composite Material)

APPENDIX-E

LIST OF PUBLICATIONS

a) Research paper in the journals

1) **Piyush Patel**, Piyush Gohil (May 2022). “Custom orthotics development process based on additive manufacturing”, Materials Today: Proceedings, Volume 59, Part 3, 2022, Pages A52-A63.
   DOI: https://doi.org/10.1016/j.matpr.2022.04.858.
   Indexed by: SJR, Scopus, Web of Science/Clarivate Analytics, UGC Care List.
   Impact Factor (TR): 1.46, SJR Rank: 0.355 | 2022, Scopus Cite Score: 2.3| 2022
   ISSN: ISSN: 2214-7853 (Online).

2) **Piyush Patel**, Piyush Gohil (August 2021). “Role of additive manufacturing in medical application COVID-19 scenario: India case study”, Journal of Manufacturing Systems, Volume 60, 2021, Pages 811-822.
   DOI: https://doi.org/10.1016/j.jmsy.2020.11.006.
   Indexed by: SJR, Scopus, Web of Science/Clarivate Analytics, UGC Care List.
   Impact Factor (TR): 9.498, SJR Rank: 2.95 | 2022, Scopus Cite Score: 15| 2022
   ISSN: Online ISSN: 1878-6642 Print ISSN: 0278-6125

3) Design and Simulation Approach of Cerebral Palsy Pediatric Standard Walker (Elsevier Journal: *Medicine in Novel Technology and Devices*: Manuscript No: MEDNTD-D-23-00002R1: Under Review Process)

4) Design, Analysis and Development of Prosthetic and Orthotic elements by Additive Manufacturing process (Springer Journal: *Biomedical Engineering Letter:* Manuscript No:BMEL-D-23-00319 : Under Review process)

5) Design, Analysis, Development and Testing of Novel Prosthetic foot model for lower limb amputation level patients (Elsevier Journal: Composite communication, Manuscript No: COCO-D-23-00508: Under Review process)

b) Presenting research work at conferences

1) Custom Orthotics development process based on Additive Manufacturing (International Conference on Materials and Technologies: NIT Raipur)
2) Design and Simulation Approach of Cerebral Palsy (CP) Pediatric Walker (International Conference on Materials and Technologies: NIT Raipur)

NITRR/Conference/MaterialTECH2022/MM48

NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR
(An Institute of National Importance)

SECOND INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGIES

MaterialTECH2022

28th –29th January, 2022

Certificate

This certificate is presented to

Mr. PIYUSH THAKORBHAI PATEL

for Oral Presentation of Paper Custom Orthotics Development Process Based on Additive Manufacturing. in the International Conference "Material TECH 2022" organized jointly by Department of Metallurgical and Materials Engineering & Department of Mechanical Engineering at National Institute of Technology Raipur, India.

Dr. N V Swamy Naidu (Organizing Secretary)
Dr. Neha Gupta (Organizing Secretary)
Dr Jagadish (Organizing Secretary)

NITRR/Conference/MaterialTECH2022/MM49

NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR
(An Institute of National Importance)

SECOND INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGIES

MaterialTECH2022

28th –29th January, 2022

Certificate

This certificate is presented to

Mr. PIYUSH THAKORBHAI PATEL

for Oral Presentation of Paper Design and Simulation Approach of Cerebral Palsy (CP) Pediatric Standard Walker in the International Conference "Material TECH 2022" organized jointly by Department of Metallurgical and Materials Engineering & Department of Mechanical Engineering at National Institute of Technology Raipur, India.

Dr. N V Swamy Naidu (Organizing Secretary)
Dr. Neha Gupta (Organizing Secretary)
Dr Jagadish (Organizing Secretary)

c) Book chapter

1) **Piyush Patel**, Piyush Gohil, Vijay Parmar (July 2021). "Bio Composite Material: Review and its Applications in Various Fields", Encyclopedia of Materials: Composites, Elsevier, 2021, Pages 80-93, ISBN 9780128197318, https://doi.org/10.1016/B978-0-12-819724-0.00011-2.

d) Patent Publication

1) Product **Patent** entitled "Multiaxial foot-ankle mechanism for prosthetic legs" granted on 14-03-2024 (Patent No: 526523).

क्रम सं/SL No :022141889

INTELLECTUAL PROPERTY INDIA

पेटेंट कार्यालय,भारत सरकार | The Patent Office, Government Of India

पेटेंट प्रमाण पत्र | Patent Certificate

(पेटेंट नियमावली का नियम 74) | (Rule 74 of The Patents Rules)

पेटेंट सं. / Patent No.	:	526523
आवेदन सं. / Application No.	:	202221034314
फाइल करने की तारीख / Date of Filing	:	15/06/2022
पेटेंटी / Patentee	:	1.Mr. PIYUSH THAKORBHAI PATEL 2.Dr. PIYUSH PRAGJIBHAI GOHIL 3.Dr. VEERENDRA KISHAN SHANDILYA

प्रमाणित किया जाता है कि पेटेंटी को, उपरोक्त आवेदन में यथाप्रकटित *MULTIAXIAL FOOT-ANKLE MECHANISM FOR PROSTHETIC LEGS* नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख जून 2022 के पंद्रहवें दिन से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled *MULTIAXIAL FOOT-ANKLE MECHANISM FOR PROSTHETIC LEGS* as disclosed in the above mentioned application for the term of 20 years from the 15th day of June 2022 in accordance with the provisions of the Patents Act,1970.

अनुदान की तारीख : 14/03/2024
Date of Grant

पेटेंट नियंत्रक
Controller of Patents

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, जून 2024 के पंद्रहवें दिन को और उसके पश्चात प्रत्येक वर्ष में उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained, will fall / has fallen due on 15th day of June 2024 and on the same day in every year thereafter.