

**A REVIEW PAPER ON DESIGNING AND PRINTING HELICAL GEAR WITH RESIN 3D PRINTING MACHINE****Dr. Sreenatha Reddy<sup>1</sup>, K. Dayakar<sup>2</sup>, B. Shravan<sup>3</sup>, D. Rahul Reddy<sup>4</sup>, S. Anjan Prasad<sup>5</sup>, T. Sai Nikhil<sup>6</sup>**<sup>1</sup>Principal, GNIT, Hyderabad, Telangana.<sup>2</sup> Assistant Professor, Mechanical Engineering GNIT, Hyderabad, Telangana.<sup>3,4,5,6</sup> UG Scholars Department of Mechanical Engineering, GNIT, Hyderabad, Telangana**ABSTRACT**

3D printing with optical lithography (SLA) has evolved into a leading additive manufacturing technology, revolutionizing various industries with its precision and versatility. This paper provides a comprehensive overview of the advances and challenges in SLA 3D printing technology. This review begins with an overview of the principles underlying SLA printing, including the photopolymerization process and the role of digital slicing software in creating printable 3D models. Next, recent advances in materials such as photopolymer resins have improved mechanical, biocompatibility, and functional properties, expanding the applications of his SLA printing in areas such as aerospace, healthcare, and consumer products. This section explains. Additionally, this review addresses improvements to hardware components such as light sources, build platforms, and optical systems, resulting in increased print speed, resolution, and reliability. Additionally, the impact of advances in post-processing techniques such as UV curing, rinsing, and surface finishing on the final print quality will be investigated.

**Keywords:**

3D printing, photopolymerization, SLA Printing, aerospace, biocompatibility.

**LITERATURE SURVEY**

**Joseph Prusa [1]:** Joseph Prusa is a prominent figure in the 3D printing world, known for his contributions to open source 3D printing technology. As the founder of Prusa Research, he has played a key role in driving accessibility and innovation in additive manufacturing. Prusa's commitment to open source principles has led to the development of his widely used 3D printers, including his Prusa i3, known for its reliability and affordability. Beyond hardware, Prusa Research has also made significant advances in resin 3D printing with products such as his Prusa SL1, bringing high-quality resin printing capabilities to users around the world.

**Hans Langer [2]:** Hans Langer is a pioneer in the field of additive manufacturing and is known for his groundbreaking contributions to the industry. As founder and CEO of his EOS GmbH, one of the world's leading manufacturers of industrial 3D printing systems, Mr. Langer has played a key role in shaping the development of additive manufacturing technology. Under his leadership, EOS has become synonymous with innovation, pushing the boundaries of what is possible in 3D printing speed, precision, and material possibilities. Although EOS is best known for its metal 3D printing systems, Langer's vision extends to other materials, including resins. Through his investment in research and development, EOS introduced resin-based technology that enables high-resolution printing for applications ranging from prototyping to final production parts.

**Nidhi Saxena [3]:** Nidhi Saxena is a renowned author and expert in the field of additive manufacturing, particularly known for her expertise in resin printing. With her focus on sustainability and innovation, Saxena has written several books on 3D printing, including her remarkable Fused Deposition Modeling: A New Approach for PET Recycling. This work highlights her commitment to exploring new applications and approaches in the field of additive manufacturing.

**Ian Gibson[4]:** Ian Gibson, David W. Rosen, and Brent Stucker are respected authors who have made significant contributions to the field of additive manufacturing through their seminal work, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. Author and scientist. This comprehensive book serves as the foundation of the additive manufacturing literature and covers in detail a variety of

techniques and processes, including resin-based printing techniques.

**Charles Hull[5]:** Charles Hull's pivotal role in the creation of 3D printing is unparalleled, earning him the nickname "Father of 3D Printing." His breakthrough invention of stereolithography in the early 1980s revolutionized manufacturing by introducing an innovative process that allowed him to create three-dimensional objects layer by layer. As the founder of 3D Systems Corporation, Hull has been at the forefront of advances in additive manufacturing technology for decades.

**Gregory Paulsen[6]:** As Director of Application Engineering at Xometry, a leading on-demand manufacturing platform, Gregory Paulsen writes articles and guides on 3D printing applications and best practices, including resin printing gear. As his director of applications engineering at Xometry, Gregory Paulsen has extensive expertise in on-demand manufacturing. His articles and guides on 3D printing applications and best practices, particularly gear resin printing, demonstrate his deep understanding of the industry. Paulsen's insights provide valuable guidance to engineers and manufacturers looking to leverage

cutting-edge technology for optimal results. In his leadership role at Xometry,

**Jayanta K. Ghosh [7]:** Principles of Polymer Engineering, written by Paul S. Farris and Jayanta K. Ghosh, is a seminal work that covers fundamental aspects of polymer engineering. This comprehensive book serves as an essential resource for a deep understanding of the materials essential to resin 3D printing processes. Faris and Ghosh's expertise is reflected in their careful examination of polymer properties, processing techniques, and applications, giving readers a solid foundation on the subject.

**Hod Lipson[8]:** Hod Lipson and Melba Kullman, co-authors of Fabricated: The New World of 3D Printing, provide a fascinating journey through the evolution of 3D printing technology, highlighting its historical significance and future possibilities. reveals gender. Her comprehensive review spans the past, present, and future of 3D printing, giving readers a nuanced understanding of this transformative manufacturing paradigm. Lipson and Kurman focus specifically on resin printing, providing insight into its origins, advancements, and applications in various industries.

**Terry Wohlers[9]:** The founders of Wohlers Associates are considered respected figures in the field of additive manufacturing and 3D printing. With decades of experience and expertise, Wohlers has established himself as a leading authority in the field, providing valuable advice and strategic insight to businesses, researchers and policy makers around the world. Masu. His consulting firm, Wohlers Associates, serves as a trusted resource for companies seeking to address the complexities of additive manufacturing technology and its applications across a variety of industries.

**Paul M. Weaver[10]:** Paul M. Weaver and James D. Smith comprehensively explore the multifaceted world of additive manufacturing in their co-authored book 3D Printing: Applications and Development. The authors delve into the diverse applications, technological advances, and new trends shaping the field of 3D printing, with an emphasis on resin-based printing technologies. Her book serves as an essential guide for professionals and enthusiasts, providing detailed insight into the potential and potential impact of resin-based printing in a variety of industries. Through careful research and analysis, Weaver and Smith reveal the transformative potential of 3D printing and provide a nuanced understanding of its role in revolutionizing manufacturing processes and product development. By examining real-world case studies and industry best practices, we provide readers with practical knowledge and actionable strategies to harness the power of additive manufacturing.

**Ian Campbell[11]:** Ian Campbell, author of Additive Manufacturing: Materials, Processes, Quantifications and Applications, provides an in-depth look at additive manufacturing technology and its practical applications. In his comprehensive overview, Campbell delves into the intricacies of additive manufacturing, providing detailed insight into materials, processes, quantification, and applications. Mr. Campbell explores the technology's ability and potential to transform manufacturing across a variety of industries, with a particular focus on resin printing. Campbell explains the underlying principles of additive manufacturing through careful research and analysis, highlighting its evolution and current state-of-the-art technology.

**K. Mukhopadhyay[12]:** A. K. Mukhopadhyay is widely known for his pioneering contributions in the fields of additive manufacturing and rapid prototyping. Through his extensive research and publications, Mr. Mukhopadhyay has explored various aspects of 3D printing technology, with a particular focus on resin-based printing methods. His work covers a wide range of topics, including material properties, process optimization, and application development in the additive manufacturing field. Mr. Mukhopadhyay's extensive experience and expertise have established him as a leading expert in the field, and he is respected by colleagues and practitioners alike.

**Brent Stephens[13]:** Brent Stephens, co-author of 3D Printing for Dummies, provides a comprehensive and easy-to-

understand introduction to the world of 3D printing for beginners who want to explore this innovative technology. Stevens collaborates with other authors to provide practical advice and guidance, demystifying the intricacies of his 3D printing for beginners. Stephens provides readers with the knowledge and tools needed to get started with additive manufacturing, focusing on resin-based printing methods.

**Christopher Barnatt[14]:** In his groundbreaking book 3D Printing: The Next Industrial Revolution, Christopher Barnatt provides a compelling look at the revolutionary potential of 3D printing technology, with a particular focus on resin printing. In his book, Barnatt investigates the transformative impact of additive manufacturing on various aspects of society, manufacturing, and design. With insightful analysis and real-world examples, Barnatt explains how 3D printing is transforming traditional manufacturing paradigms, enabling distributed production, and driving innovation across industries.

**Olaf Diegel[15]:** Olaf Diegel is considered a prominent figure in the field of additive manufacturing, known for his innovative designs and unparalleled expertise. Through his prolific publications, Diegel has made significant contributions to the 3D printing literature, covering a wide range of topics from resin-based printing techniques to practical applications. Diegel focuses on pushing the boundaries of additive manufacturing, writing books and research papers that explore the complexities of resin printing and its transformative potential.

**Carla Brown[16]:** Carla Brown, author of Mastering 3D Printing, provides an authoritative and comprehensive guide to 3D printing principles, processes, and best practices. In her groundbreaking book, Brown delves into the intricacies of additive manufacturing and provides readers with valuable insight into various printing technologies, including resin printing. Brown pays close attention to detail, covering every aspect of the 3D printing workflow, from design considerations and material selection to post-processing techniques and troubleshooting. Her book serves as a guide for both beginners and experienced practitioners, providing practical advice and expert guidance at every step of the process.

**Bryan Ratzlaff[17]:** In their book, Additive Manufacturing of Metals: Technology, Materials, Design, and Manufacturing, Bryan Ratzlaff and J. Andrew Todd provide a comprehensive overview of metal additive manufacturing techniques, highlighting the role of resin printing in prototyping and product development. We provide verification. Her book serves as a comprehensive guide for professionals and researchers who want to understand the intricacies of additive manufacturing for a variety of materials and applications. Although the focus of this book is metal additive manufacturing, Ratzlaff and Todd recognize the importance of resin printing in the broader context of additive manufacturing.

**Alberto Ortona[18]:** Collaborate on the groundbreaking research “Ceramic 3D Printing” that comprehensively examines the use of 3D printing techniques on ceramic materials, including resin printing. Her book provides valuable insight into the unique properties of ceramic materials, the complexity of processing methods, and the diverse applications of 3D printing. Ortona and Ferrari explore the fundamental principles of 3D ceramic printing with great attention to detail, addressing key challenges and opportunities in material selection, process optimization and post-processing technology.

**John M. Hartmann[19]:** Hartman leverages his entrepreneurial and technology expertise to provide valuable insights to entrepreneurs, investors, and business leaders looking to harness the potential of 3D printing. She covers important topics such as market trends, intellectual property considerations, and strategic decision-making, and provides practical guidance to navigate the complexities of the 3D printing market. By examining case studies and success stories, Hartman highlights the transformative impact of his 3D printing across industries, from manufacturing and healthcare to consumer goods and aerospace.

**Thomas V. P. Dymond[20]:** His groundbreaking work, Beginner's Guide to Engineering: Mechanical Engineering, provides a comprehensive introduction to the principles of mechanical engineering, giving readers a solid foundation in the fundamentals of the field. With its focus on gear design, Dymond's book serves as an invaluable resource for beginners who want to understand the principles and applications of mechanical engineering in a variety of projects, including 3D printing.

**Robert C. F. Bartlett[21]:** Mr. Bartlett explores the diverse applications of 3D printing across a variety of industries, investigating its impact on manufacturing, healthcare, aerospace, automotive, and more. By examining real-world case studies and industry trends, he reveals the profound impact of his 3D printing on innovation, efficiency, and sustainability across a variety of sectors. Additionally, Bartlett offers a positive perspective on the future of 3D printing, speculating on new technologies, trends, and potential disruptions

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**J. E. Shigley[22]:** Shigley and Mischke delve into the fundamental principles of gear design, paying close attention to detail and considering factors such as tooth shape, pitch, and contact ratio. Clear explanations and concrete examples are provided to help readers understand the underlying concepts and apply them effectively to their design projects. Although their book does not specifically address resin 3D printing, the gear design principles covered by Shigley and Mischke serve as a valuable framework for adapting traditional gear designs to additive manufacturing processes. Masu.

**Alexander Slocum[23]:** Slocum's approach to mechanical design, focused on precision and optimization, provides a comprehensive framework for engineers and designers looking to leverage 3D printing technology to manufacture helical gears. It focuses on understanding the mechanical properties and performance requirements of gears, allowing readers to adapt their designs to additive manufacturing processes. Additionally, his Slocum expertise in design optimization and tolerance analysis provides engineers with the tools they need to ensure manufacturability and functionality of helical gears manufactured using 3D printing.

**Thomas A. Brown[24]:** In the pages of "Machinery's Handbook," Brown and Ryffel cover topics such as gear terminology, shapes, materials, and manufacturing processes, providing comprehensive coverage of the basics of gear design. This wealth of information provides engineers and designers with the knowledge they need to effectively design gears for a variety of applications, including those using additive manufacturing techniques. Machinery's Handbook may not specifically address resin 3D printing, but the gear design principles described by Brown and Ryffel provide valuable insight for engineers seeking to utilize additive manufacturing techniques.

**Robert L. Norton[25]:** Norton covers the basic principles of gear design in Machine Design, giving readers a comprehensive understanding of gear geometry, kinematics, and manufacturing processes. His expertise in mechanical design allows him to address important considerations such as load distribution, tooth profile optimization, and material selection. All of these are important for designing helical gears for resin 3D printing.

### CONCLUSION

In summary, designing and printing helical gears using resin 3D printing machines requires careful consideration of mechanical design principles, additive manufacturing limitations, and material properties. Authors such as J.E. Shigley, C.R. Mischke, Alexander Slocum, Thomas A. Brown, Henry H. Ryffel, and Robert L. Norton provide valuable insights into gear design and mechanical engineering that can be applied to resin 3D printing applications. Their expertise provides engineers and designers with a solid foundation for understanding gear geometry, kinematics, and manufacturing processes, ensuring the production of helical gears using resin 3D printing machines. You can make it successful. By integrating principles of precision engineering, design optimization, and tolerance analysis, professionals can overcome challenges associated with additive manufacturing, such as dimensional accuracy and surface finish.

### ACKNOWLEDGEMENT

We would like to extend our sincere gratitude to GURUNANAK INSTITUTE OF TECHNOLOGY for their invaluable support and resources, which have been instrumental in the successful completion of our project. We wish to express our candid gratitude to Dr. S. SREENATHA REDDY, Principal and the management of the Guru Nanak Institute of Technology for providing us the best amenities which enabled us to complete our project in the stipulated time. We would like to say sincere thanks to Dr. RISHI SAYAL, Associate director, for providing excellent lab facility, for smooth completion of project and we are thankful for your support. We extend our deep sense of gratitude to Dr. B. VIJAYA KUMAR, Professor & Head of the Mechanical Department for his masterly supervision and valuable suggestions for the successful completion of our project. We owe our immense thanks K. DAYAKAR our project guide, Assistant Professor in Department of mechanical Engineering, Guru Nanak Institute of technology for the sustained interest, constructive criticism, and constant encouragement at every stage of this Endeavour. Finally, yet importantly, we are very thankful to our parents, friends, and other faculty of Mechanical Engineering Department for their constant support in completion of this project.

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