Instructions for design of metalens with Moxtek's design library:

1. Download the zip folder from Moxtek. Copy the meta-atom library files to your Zemax project folder.
2. In Zemax OpticStudio, add a surface to represent the metalens. The surface can be either of type “Binary 2”, or “User defined” with the dll file set as "us\_binary\_mix12\_231020.dll". The Binary 2 element can only create radially symmetric lenses, but the user defined surface can create non-symmetric lenses that incorporate cartesian terms (X^n Y^m). For either surface, optimize the coefficients to fit your needs.
   1. For the “Binary 2” surface, leave the radius terms at zero and adjust only the terms starting with “Maximum Term #”. Leave “Diffract order” equal to 1.
   2. For the “User defined” surface, leave the parameters "Par Pow Mode" and "Custom Pow" equal to zero because they are not relevant for optimizing the phase profile of the metalens.
   3. The metalens surface should be on a flat piece of glass. The material to use is “Eagle-XG.dat” (found in the zip folder) which describes Eagle XG display grade glass from Corning.
3. Copy the coefficients of the surface element to a csv file, with the value on the second line.
   1. For the “Binary 2” surface, the first value is “Max Term #”. See the template “lens design coefficients -Binary 2.csv” included in the zip folder.
   2. For the “User defined” surface, the first coefficient is Rnorm. Make sure that “Diffraction Order” is equal to 1. See the template “lens design coefficients -us\_binary\_mix12\_231020.csv” included in the zip folder.
4. In Lumerical, open the script "Generate\_metalens\_with\_Moxtek\_library.lsf". Change the entries in the section called User Settings to match your needs, but please leave the code after it unchanged to avoid errors.
   1. Comment/uncomment the value of surface\_type according to the type of surface selected earlier.
   2. Update the metalens\_coefficient\_table variable to the name of the csv file with your lens coefficients.
   3. Update the lens\_radius and comment/uncomment the meta-atom library file that you want to use.
   4. Comment/uncomment propagation\_direction (select air-to-substrate if the light rays propagate from air through the metalens and into the substrate; select substrate-to-air if they proceed in the reverse direction).
   5. Run the script.
5. Copy the generated .h5 metalens file to your Zemax surfaces folder (typically located at C:\Users\username\Documents\Zemax\DLL\Surfaces\).
6. In Zemax OpticStudio, change the user-defined surface dll from "us\_binary\_mix12\_231020.dll" to "lumerical-metalens-2025R1-2-20250120-307ab4f9d1.dll".
   1. Change the "Aperture->Maximum radius" surface property to the size of your lens in mm.
   2. Change the comment to the name of the metalens file you copied in the last step (including the '.h5' extension). Make sure that Set "Make Log" is to 99, "Method" to 1, "Window size" to 100, and "Order" to 0. For more information on these parameters, please see the tutorial here: <https://optics.ansys.com/hc/en-us/articles/18254409091987-Large-Scale-Metalens-Ray-Propagation>.
   3. Reload all surfaces.
7. A simulation of a Moxtek metalens with your specifications should now be working in your optical system.