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STUDY AND DESIGN OF PALM FRONDS PRUNING MACHINE

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Abstract

The date palms are the hub of agriculture in the Algerian desert; the oasis creates a microclimate suitable for growing fruit trees, grain crops and vegetables. Nearly 18 million palm trees are planted on an area of 169380 hectares; among them, ten million trees produce an annual yield of 500000 metric tons of dates, unfortunately only few of them are exported due to the poor marketing strategies.

There is also the serving of palm trees, they need to be pruned to improve their production, and this is a risky work that many workers avoid by fear of the possibility of falling and the risks of working in highs.

To contribute in solving this problem, we present in this work a solution that can provide a pruning service without risking lives. We have got the idea to concept a robot remotely guided that can climb the palm tree and prune it.

المخلص

نخيل التمر هي محور الزراعة في الصحراء الجزائرية. تخلق الواحة مناخاً محلياً مناسباً لزراعة أشجار الفاكهة ومحاصيل الحبوب والخضروات. ما يقرب من 18 مليون نخلة مزروعة على مساحة 169380 هكتار ؛ من بينها ، عشرة ملايين شجرة تنتج عائداً سنوياً قدره 500000 طن متري من التمور، وللأسف يتم تصدير القليل منها فقط بسبب ضعف استراتيجيات التسويق.

هناك أيضاً خدمة لأشجار النخيل ، فهي بحاجة إلى تقليمها لتحسين إنتاجها ، وهذا عمل محفوف بالمخاطر يتجنبه العديد من العمال خوفاً من احتمال السقوط ومخاطر العمل في المرتفعات.

للمساهمة في حل هذه المشكلة، نقدم في هذا العمل حلاً يمكن أن يوفر خدمة التقليم دون المخاطرة بالأرواح. لدينا فكرة تصور روبوت موجه عن بعد يمكنه تسلق شجرة النخيل وتقليمها.

Résumé

Les palmiers dattiers sont la plaque tournante de l'agriculture dans le désert algérien ; l'oasis crée un microclimat propice à la culture d'arbres fruitiers, de céréales et de légumes. Près de 18 millions de palmiers sont plantés sur une superficie de 169380 hectares ; parmi eux, dix millions d'arbres produisent un rendement annuel de 500 000 tonnes métriques de dattes, malheureusement seuls quelques-uns d'entre eux sont exportés en raison des mauvaises stratégies de commercialisation.

Il y a aussi le service des palmiers, ils ont besoin d'être taillés pour améliorer leur production, et c'est un travail risqué que de nombreux travailleurs évitent par peur de la possibilité de tomber et des risques de travailler en hauteur.

Pour contribuer à résoudre ce problème, nous présentons dans ce travail une solution qui peut fournir un service d'élagage sans risquer des vies. Nous avons eu l'idée de concevoir un robot téléguidé capable de grimper sur le palmier et de le tailler.

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General Introduction

The palm sector is gaining increasing importance to the national economy in Algeria. The total area planted for date palms in Algeria is 162372 hectares (the total number of palm trees is about 18 million). We also mention that the Algerian palm sector includes about 800 varieties of date palms. [1]

Palm trees are monocotyledonous, dichotomous and unisexual trees (male and female trees) with cylindrical upright unbranched stems bearing leaves on the upper end (the growing apex), and their height may reach 30 meters. [1]

Its leaves are a feathery compound called the fronds (fronds) and bear thorns at the base. The leaves are covered with a waxy layer to protect them from the environmental conditions in which they live. The length of the leaves ranges between 3-5 meters and in some varieties up to 7 meters. [1]

The flowers begin to appear in the form of leather bags or receptacles called the jarred or (jaf), and when they split, they appear in the form of a feminine or masculine inflorescence, depending on the type of palm. Due to the peculiarity of this tree, it needs pruning. [1]

This process is considered one of the important operations for the palm, where the dry fronds and thorns are removed from the bases of the leaves, they are cut and the fibers are removed from around the stem. Palm pruning aims to:

- Get rid of dry and infected fronds.
- Extract the thorns from the bases of the fronds so that it is easier to carry out service operations on the top of the tree.
- Improve lighting and reduce humidity around the vineyard. [1]

The date of pruning varies in different regions, but it is done once a year in early spring with the pollination process, or in the summer when the process of curving and drooping the stalk is carried out, or in the fall after harvesting the crop, which is the optimal period for this

process so that the tree can benefit from all the stock of fronds of nutrients in order to form new inflorescences.[1]

We can notice that palm trees in the wild are not pruned on a regular basis so some people wonder why they need to prune theirs. Palm trees that are not taken care of can be hazardous. Fronds that are not pruned will begin to fall on their own, which can cause accidents or injury. These fronds can be a fire hazard if left unattended, not to mention they are very unattractive and distracting from the rest landscape. [1]

This study is a direct contribution in this important sector for our country, where we will present the study and design of a palm frond pruning machine. This work is presented into three chapters, the first chapter is devoted to a bibliographical research in the field of the mechanization of pruning since the industrial revolution and Get an overview of this process and its history, and reveal the most important obstacles facing this process.

In the second chapter we will take a closer look at the different methods and materials used in the pruning process and extract the most important positive and negative points and the extent of their contribution to help provide solutions to the problem at hand.

The third and the most important chapter where we going to Where we will get closer to the general design of pruning machines by embodying them in 3D in the Solidworks system where we will get closer to the general design of the pruning machines by embodying them in the SolidWorks system and giving a detailed look of the parts of the machine.

Note :

- *Monocotyledonous* : a flowering plant with an embryo that bears a single cotyledon (seed leaf). Monocotyledons constitute the smaller of the two great divisions of flowering plants, and typically have elongated stalkless leaves with parallel veins (e.g. grasses, lilies, palms).
- *Dichotomous* : dividing into two parts

Chapter I

Bibliographical study

I.1 Introduction

Pruning is one of the most misunderstood aspects of palm culture. Correctly pruning any plant or tree can benefit the growth and health of the plant. If they are maintained correctly, palms are low maintenance trees. [2]

For some reason, some people believe that they can indiscriminately hack at palms, including the periodic removal of most or nearly all of the fronds (leaves), several times each year, and not harm the tree. Palms are not an exception to good pruning rules. Poor pruning techniques will harm any plants or trees, including palms. [2]

There is a misconception that the more a palm is pruned, the faster it will grow. This is not true. Many palm specialists discourage over-pruning except when transplanting certain species. Others simply recommend avoiding pruning as much as possible. [2]

In this chapter, we will present a comprehensive study on the history of pruning technology and the techniques available in the market, in addition to the most important problems and obstacles facing those responsible for this process. [2]

I.2 Objective of this study

Due to the importance of the agricultural sector in Algeria, and in particular the importance of palm trees and its impact on the economy, this study has the aim to focus on the issue of caring palm trees, especially at the pruning stage, and what are the required conditions to reach a successful and fruitful process, which is a problem that farmers are facing every year.

I.3 Palms status and perspective in Algeria

Date palm is the axis of Algerian Saharan oasis agriculture creating a microclimate suitable for the cultivation of fruit trees, cereal crops, and vegetables. [3]

Date palm cultivation is subject to abiotic and biotic constraints including diseases like bayoud which destroyed millions of palm trees in southwestern Algeria and continues to expand despite prophylactic measures taken by the Plant Protection Services. Traditional and modern techniques are utilized equally in the operations of small and large farms.[3]

Various problems related to agricultural practices keep the yield per tree low in comparison to the surrounding regions. Approximately 18 million date palms are cultivated on an area of 169,380 ha; out of these, ten million trees are producing an annual yield of 500,000 mt of dates. Exports of Algerian dates are small because of weak marketing strategies.[3]

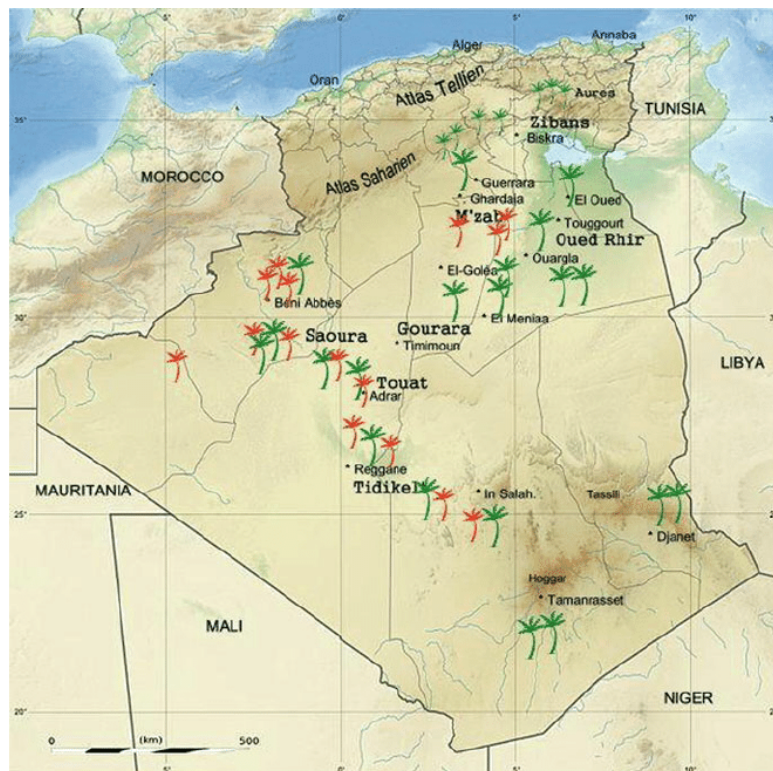


Figure I-1: Map of Algeria indicating the different areas with date palms; (in red are bayoud infested, those in green not infested) [3]

A program for the development and expansion of date palm agriculture was implemented by the Ministry of Agriculture and Rural Development (MADR) in the recent years. Moreover, research on propagation, improvement, and evaluation of Algerian date palm cultivars is receiving attention by researchers in various universities and research. [3]

I.4 Importance of palm trees in the Algerian economy

Dates are one of the most important agricultural products in Algeria, the country witnessed an abundance of dates production during the past year, with a production of 1.2

million tons of dates in 2019, through 18.6 million palm trees, distributed over 167,000 hectares, and more than 300 types of dates.

The amount of Algeria's production of dates is equivalent to 14 percent of global production, according to figures from the Algerian Ministry of Agriculture.

The value of Algeria's exports of dates in 2019 amounted to nearly \$39 million. France is the first customer for Algerian dates with 13,400 tons in 2019, followed by Russia with 3,300 tons, then the United Arab Emirates with 1,600 tons, India with 1,100 tons, and the United States of America with 1,000 tons

the production of dates in Algeria has increased, as it moved from 600 tons in 2012 to about one million and 100 thousand tons in 2017, with a rate of 3% of it is destined for export, explaining that her country is outstanding and one of the most important countries producer.

Dates - ranked fourth in the world with 14% of global production - but the value of exports amounted to 37 million dollars in 2019, and this value does not reflect the available possibilities.

The number of palms in Algeria is 18.6 million palm trees planted on an area of 167,000 hectares (a hectare is equivalent to 10 kilometers), according to figures issued by the Ministry of Agriculture at the end of 2018, while unofficial statistics indicate that there are more than 21 million palm trees in the country.

The province of Biskra in the southeast of the country is considered the first locally in terms of production, as it alone provides about 42% of the total production, followed by the El-Oued border governorate with Libya, which limits 25% of production.

Algeria occupies a distinguished and advanced position in the number of palm trees and the production of dates in the world It is ranked sixth in terms of total global production, and second in Africa after Egypt. The importance of palm wealth as a main axis revolves around the life in the desert areas through its role in the stability of 2.2 million people in these areas.

The visitor also has more than 15 million palm trees, and more than 800 trees of dates, which constitute an important genetic stock.

Algeria has exported more than 1,000 tons of dates to France and Mauritania in light of the global crisis of Corona.

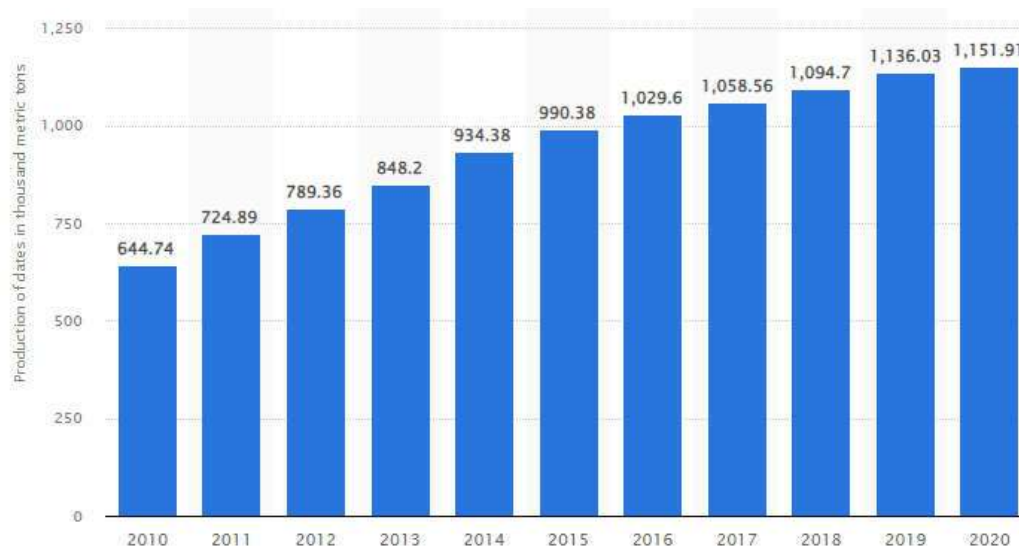


Figure I-2: Production of dates in Algeria from 2010 to 2020[12]

Table I-1: Top 5 ranked countries in date production

Rank	Country	1000 metric tones
1	Egypt	1,373,75
2	Saudi Arabia	1,122,80
3	Iran	1,018,61
4	The U S A	900
5	Algeria	690

I.5 Types of palm trees

Palms are usually divided into two groups, the feather palms and the fan palms. Feather palms are distinguished by pinnate leaves and fan palms have, of course, palmate leaves. Most have similar cultural requirements but they may vary in their sensitivity to cold.[11]

Feather Palms				
Common Name <i>Botanical</i>	Description	Height	Comments	Form
Queen Palm <i>(Syagrus romanzoffiana)</i>	Tall, graceful palm with prominent rings on smooth gray upright trunk	30-40 ft.	Best in tropical looking landscapes, near pools and courtyards. Medium to high water use. Sensitive to severe frosts.	
Pindo Palms <i>(Butia capitata)</i>	Gray-green arching fronds with a stocky trunk. Edible fruit.	10-20 ft.	Medium to high water use, best with deep infrequent irrigation. Slow growth rate.	
Canary Island Date Palm <i>(Phoenix canariensis)</i>	Large, wide spreading palm. Dark green leaves with orange midribs. Trunk is columnar in maturity. Can be grown in container. Crosshatch pattern on trunk.	Slow to 40-50 ft.	Excellent for large gardens, parks with medium water use. Fruit can be messy. Frequent pruning can become expensive.	
Date Palm <i>(Phoenix dactylifera)</i>	Rough textured trunk with feathery broad-spreading green gray foliage. Stiff and formal foliage but trunk is more graceful than Canary Island Palm.	Slow to 50-60 ft.	Too messy for pool or patio use. Remove side shoots to maintain single trunk.	

Figure I-3: Feather palms [11]



Fan Palms				
Common Name <i>Botanical</i>	Description	Height	Comments	Form
Mexican Blue Palm <i>(Brahea armata)</i>	Silvery-blue leaves in a graceful arch with erect columnar trunk. Robust at maturity.	Slow to 25-30 ft.	Very versatile palm useful as a landscape plant or container plant. Blue foliage is a nice contrast plant. Tolerant of a wide range of growing conditions.	
Guadalupe Fan Palm <i>(Brahea edulis)</i>	Robust handsome palm with bluish foliage but faster growing and fewer flower spikes.	Slow to moderate growth to 20-30 ft.	Can be used as specimen, in-group plantings or in containers. Widely adapted to a range of growing conditions. Favors deep, infrequent irrigation. Old leaves self-prune.	

Figure I-4: Fan palms [11]

I.6 Palm control and care

Provided dates production needs strict care to palm trees to avoid exposure to various diseases and viruses that cause their atrophy and death. The process of palm care includes a very important stage, which is pruning, as it requires so much effort and the human factor in it is important.

I.7 Pruning palm trees

I.7.1 Definition

Palm pruning is to removes dying or dead fronds or fruiting clusters. Pruning is typically conducted at least twice a year. It is best for the palm if green fronds remain unharmed. Palms that are over pruned may have a slower growth rate and can attract pests. [4]

I.7.2 Reasons to prune palm trees

We count:

- Removing dead or dying fronds that might harbor insect pests, such as roaches and scorpions.
- To remove hiding places for other pests such as rats.
- To remove potential fire hazards in urban areas near homes and other buildings.
- For safety reasons; so that views from driveways, sidewalks and safety signs are clear. Blocked views are most often caused by planting palms in the wrong places.
- To prevent damage to buildings and walls during high winds. Planting palms too close to a building can cause damage to the structure. Palms don't need to be protected from high winds by pruning. After Hurricane Andrew, the few trees left standing were palms. Most had few if any fronds left from the high winds, but they were still standing.[2]

I.7.3 Best time for palms to be pruned

Palm pruning is done primarily for aesthetic purposes. From the palm's perspective, there is no one time of the year that is better than another. [5]

Pruning dead leaves prior to hurricane season may reduce the chances that these easily detached leaves will become missiles in a storm. [5]

Ideally, a dead leaf would be pruned whenever it appears on a palm, but that simply isn't practical unless the palm is located in your own yard and is small enough to be easily accessible with common pruning tools. [5]

Commercially, palms are pruned on a fixed schedule (e.g., yearly, semi-annually, etc.) or whenever the palm's appearance becomes unacceptable to the owner. [5]

Conventional gardening wisdom holds that the best time to trim a tree is during its dormant season. [5]

This is essentially when the tree hibernates to recover from all the growing it did during other times of the year. It's also a survival tactic when the weather cools off—it allows the tree to avoid growing during an inhospitable season when it's much harder to keep new growth alive. [5]

Palm trees have a dormant period, just like any other tree. This happens around fall and winter when the weather cools off (not much, since this is in Florida, but it's cooler than a palm tree's preferred growing weather). Palm trees have stunning dormancy ability, especially in their seeds—a 2,000-year-old seed from a palm tree was able to sprout.

However, this does not mean that you should trim a palm tree during its dormant season. [5]

I.7.4 Pruning limitation

Removing most of the leaves (fronds) yearly or more frequently weakens the palm and slows its growth. Mature fronds provide food for developing fronds, flowers, fruit, roots and storage reserves in the trunk. [2]

When green fronds are removed, the nutrients they would have produced are lost to the rest of the palm. Some nutrients move from older leaves to newer leaves as they die. With potassium (and to lesser extent other nutrients deficiency) removal of older green or chlorotic leaves exacerbates deficiency. [2]

Nutrient deficiencies also cause narrowing of the trunk and decline in the size of the fronds. The palm must now obtain its potassium from younger leaves in the canopy. These previously green and healthy leaves will then become chlorotic and unsightly. Regular removal of potassium deficient leaves can eventually kill the palm.

Palms must store sufficient reserves of starch in their trunks that can be mobilized to restore fronds in the event that a palm experiences some type of stress such as fire, frost or defoliation by humans. Palms must have as many green fronds as possible to produce a continuous supply of food to grow, stay healthy and build storage reserves. [2]



Figure I-5: Over pruned palm[10]

Fronds may take 3 to 5 years to mature. A large crown of leaves on a mature date palm with over 125 fronds may have taken 15 years to develop from the most juvenile frond to the most mature frond. This includes those primordial leaves in the bud that are not visible.



Figure I-6: Damaged fronds by high winds[10]

Palms leaves are designed in a cantilever effect to facilitate survival in high winds. When too many fronds are removed, the palm can be more easily damaged. Immature fronds that have

been robbed of the support and protection of mature fronds are more susceptible to wind damage, desiccation and structural failure. [2]

Research has shown that mature fronds are those found below the current year's blooms. When pruning, we should leave at least two rows of mature fronds, preferably more. [2]

1.8 Labor importance in caring for palm trees in Algeria

The date production branch in Algeria faces many difficulties, such as **pests that affect yields**, lack of **production requirements**, lack of funding, and lack of **qualified labor...**

The shortage of qualified manpower and the high wages of workers, which made the farmers' farmers not to carry out some agricultural operations, which negatively affects the productivity of the single palm tree.

There is no doubt that the labor force represents an essential element in the issue of caring for palm trees, as the shortage of this element represents a threat to the palms , Which leads to affecting the production of dates.

The agricultural sector in Algeria is facing an alienation of labor from it, which has created a crisis in a field on which the government is betting a lot to revive the country's economy, which is suffering from financial crises due to the decline in oil revenues, due to the continued low prices of selling crude globally.

According to the latest figures issued by the Algerian Bureau of Statistics, the agricultural sector currently employs about 1.2 million people, representing 8.7% of the country's labor force, after it employed 2.5 million workers in 2019, of whom 1.9 million are permanent and the rest are seasonal workers.

The deficit recorded by the agriculture sector since the beginning of the year, according to the Ministry of Agriculture and Fisheries, amounts to about 800,000 manpower, which made landowners and female investors in particular face a severe crisis at the beginning and end of each agricultural season, specifically when the crop is planted and harvested. [13]

Chapter II

Materials and Methods

II.1 Introduction

In this chapter, we will focus on the various methods that were used within the pruning process, and most importantly, propose a solution to the problem posed in the first chapter.

This palm pruning process can be divided into two different styles:

II.1.1 Manual pruning

At the early stage when the trees are short, pruning is a relatively simple operation for trees below 3m height. On the other hand, for trees above 3m height, the combination of a sickle attached to a long pole is used.

As the trees grow taller, manual pruning with a sickle-pole method is a hindrance since this process becomes increasingly difficult. [6]

Pruning the date leaf and leaf-end has been from the research subjects. There are different pruning machines in the country; from them, we can refer to Makita returning blade self-charge model, Bush circular blade, and Haskovarna sprocket blade, which an example of them has been shown in Figure 5. It should always use the cutting instruments that provide a clean-cut. It has been suggested to use a solution of water and bleaching agent and keep the blade in it for five minutes to sterilize it.



Figure II-1: Short palm tree pruning [10]

Handling and maneuvering the long flexible pole that is two to eight times the length of human body with a sickle at its end is an extremely arduous and hazardous task.

The long pole increases the moment acting on the worker. Therefore, the worker has to be highly skilled in handling the tool besides having enough energy to perform the cutting task [6].



Figure II-2: Longer palm pruning [10]

Working under this circumstance also increases the risks of injuries and musculoskeletal disorders [6].

To overcome this, mechanization of the harvesting process has to be implemented with the introduction of new harvesting technology which is more economical and efficient [6].

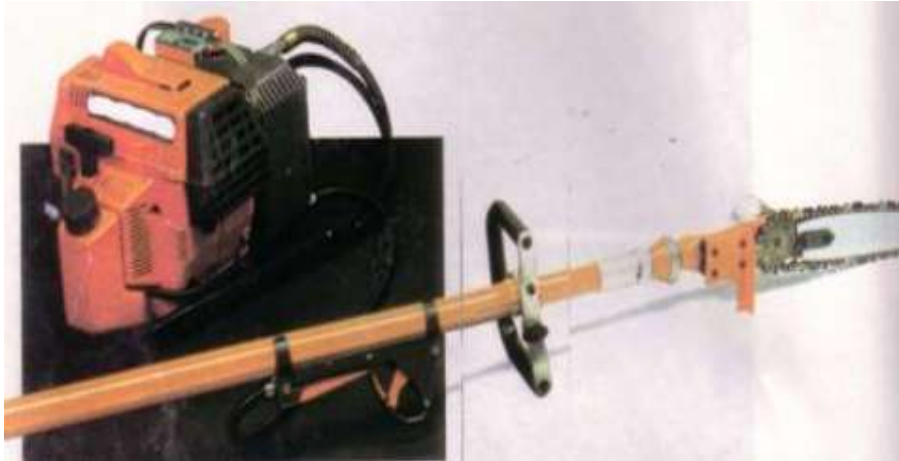


Figure II-3: Pruning machine equipped with the sprocket blade and canvas [7]



Figure II-4: The hand and basis of the machine which have been made based on the physical characteristics of the manual pruning device [7]



Figure II-5: Imported pruning devices[7]

II.1.2 Machine pruning

The concept of mechanized is preferred in pruning of tall palms, they are listed as follows: at first mounting the cutting mechanism on a mobile climbing platform which enables pruning at close proximity; and second, attaching a cutting tool at the end of a boom where operation is controlled from the ground. [6]

Research on the second option is more popular and different types of cutting mechanisms have been developed, which some ones of them were mounted on tractors for testing purposes. Figure III-6 shows the string cutting mechanism mounted on the tractor. [6]



Figure II-6: Wire cutting mechanism mounted on tractor[6]

Figure III-7 presents a string cutting mechanism, cutting is achieved through a continuous rotation of the string at rapid speed and the wire tension is controlled by the extension of the hydraulic actuator.[6]

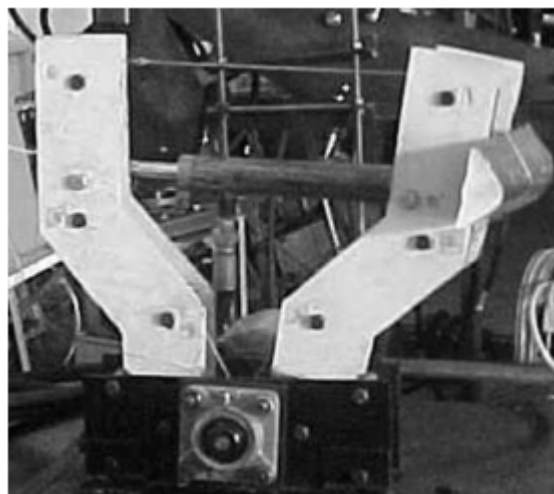


Figure II-7: Cutting frond with wire cutting mechanism [6]

For a continuous rotation system, joining the string to form a loop introduces a knot and this is the major drawback of this mechanism. Occasionally, the wire loop snapped due to the excessive force and the lack of bonding strength on the knot. [6]

During trials, cutting was performed by placing the rotating string cutter under the fronds or bunch stalks and applying the cutting force upwards. [6]

Cutting would then stop abruptly when the string was clamped under the weight of the frond or fruit bunch. [6]

II.1.3 Climbing robots pruner

Research on climbing robots is gaining popularity and they will be expected to play a significant role especially in the agricultural sector in the near future. Research on tree climbing robots has hitherto focused on a small array of applications, such as in the forest management and coconut industry. [6]

From a research point of view, it is necessary for this type of research to look into designing, utilizing and harnessing the full potential of climbing robots to perform labor intensive, time consuming and dangerous tasks. [6]

Realizing the need to mechanize the harvesting process, MPOB developed an enormous hydraulically powered electromechanical climber in 1989. [6]

Climbing was achieved by four 700 mm-diameter wheels with protruded triangular teeth to enhance traction and to prevent the robot from slipping. [6]

The square shaped-platform design however was not optimized for use on trees with circular cross section. It would prevent the cutting tool from reaching all the fruits around the trunk. [6]

In addition to its enormous size, most parts in the structure were made of steel and this increased the weight of the robot considerably. [6]

Furthermore, the wheels and the arm mechanisms that were used for gripping the tree trunk were all driven by a huge and heavy hydraulic power source. [6]

The diameter of the wheel was large in order to allow it to generate as much contact as possible with the trunk surface. However, the circular shape of the wheel only allowed a small portion of the wheel to make such contact. [6]

The rest of the wheel surface did not contribute to the traction generation at all. Another problem encountered when operating the MPOB robot was that it did not have the ability to ensure that the platform was level [6].

Failure to maintain its balance caused it to tilt to one side and the trunk started to impede the frame of the robot and this affected its movements [6].

Another version of a lighter climber was developed at UPM . Unlike its predecessor, it has integrated tilt sensors to detect its own orientation. During trials, it was able to remain levelled when climbing the tree, as shown in Figure II-8. [6]



Figure II-8: Climbing robot with tilt sensors [6]

Instead of using rubber wheels, this robot uses 16 small sprockets for climbing (Figure II-9). Its traction was generated with the help of a passive spring mechanism, as shown in (Figure II-10). This type of mechanism is a passive-gripping mechanism designed for climbing trees with relatively smooth trunks of approximately 300 mm to 420 mm. [6]



Figure II-9: Robot climbing smooth trunk using small sprockets [6]

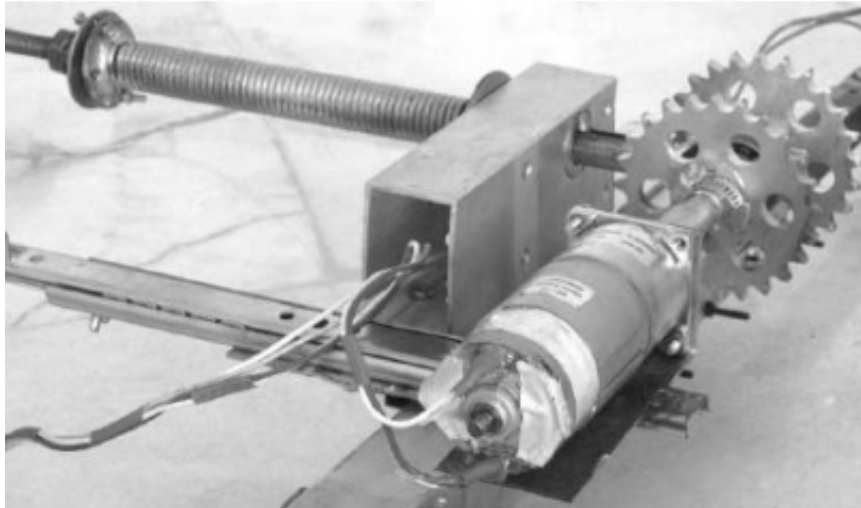


Figure II-10: Passive-gripping mechanism [6]

For trees with different diameters, the power screw connected to the spring has to be manually adjusted to stretch and contract the spring. This is to ensure sufficient gripping force but it comes with a tradeoff in terms of flexibility of the sprockets in negotiating irregularities on the trunks. [6]

II.1.4 The automated palm tree trimmer

a) Benefits

- This machine helps to get rid of the climbing problem of long palms
- Supports two movements at the same time, ascent and rotation
- Contains three cutting discs



Figure II-11: Automated palm trimmer

b) Defects

- Its size is very large, as it requires at least three people to install it.
- Not compatible with all diameters of trees, small diameters only(20-30cm).
- It is not suitable for the conditions of the surfaces of palm trees, as its mechanics do not help climbing along the palm.
- It contains an excessive amount of cables, which hinders movement.

II.2 Study of the different sizes (diameters) of palm trees

The palm stem is an upright, cylindrical, unbranched, rough-surfaced stem covered with fronds (the bases of the leaves) ending in a dense crown of large leaves. The average height of the trunk is about (10 m) and may reach (25 m), and the diameter ranges between (40- 80 cm)

And for the purpose of designing a pruning machine suitable for all or most of the palm trees, we conducted an experimental study. Where we moved to the palm grove and measured the diameter of about 100 palm trees. Where we have obtained the results shown in the table below. The measurement results were confined between 40 and 80 cm. Through eye observation, we find that most if not say that all the palms in the "Oued Reigh" area have the same size



Figure II-12: Feeding Picture during the diameter measurement process

Table II-1 :A table showing the diameters of 100 palm trees

Diameter (cm)	40	45	50	55	60	65	70	75	80
Number of palms	1	6	17	23	37	4	10	1	1

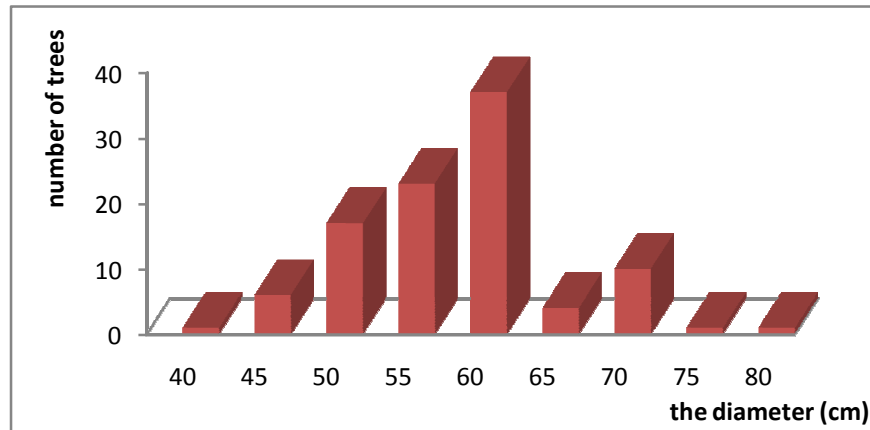


Figure II-13: Different diameters of 100 palm trees

II.3 Pruning process

Generally, pruning a palm tree by using a climbing machine needs a source of energy to climb then cut the desired fronds:

- The electric generator will be the only source of energy to run this machine, and looking at the amount of energy needed, 1000 W is enough energy to start with.
- The added thing in this project is to provide the machine with a camera installed next to the cutting tool to give a better view to the user while acting.

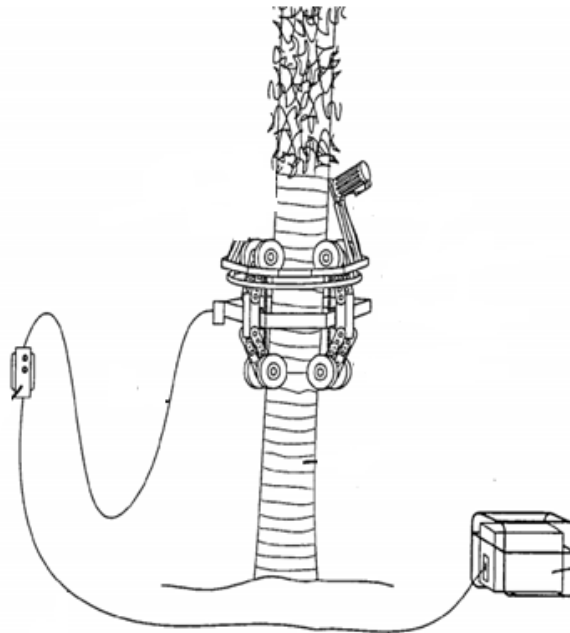


Figure II-14: General view for the pruning process[13]

Chapter III

Simulation and design

III.1 Introduction

In this chapter we will establish 3D models of the different parts of the pruning machine system considering preliminary, describe the prototype of this project that we propose, Based on the definition of basic components, with the definition of the program used in the design and study of this model.

III.2 Used software

For 3D modeling we have use SolidWorks software which is a solid modeling computer - aided design (CAD) and computer-aided engineering (CAE) computer program that runs on Microsoft Windows.

SolidWorks is published by Dassault Systèmes, an European software company headquartered in France that develops 3D design, 3D digital mock-up, and product lifecycle management (PLM) software. SolidWorks was created in 1993 by the eponymous American publisher, and acquired on June 24, 1997 by Dassault Systèmes. According to the publisher, over two million engineers and designers at more than 165,000 companies were using SolidWorks as of 2013. Among the largest organizations using SolidWorks, we can mention Franckie, Packaging Equipment MMC, AREVA, Patek Philippe, Mega Bloks, Axiom , ME2C, SACMO, Le Boulch, Robert Renaud, Lorenz Baumer, the Paris Opera , Jtekt, GTT and the French Ministry of Education.

III.3 Modeling technology

Building a model in SolidWorks usually starts with a 2D or 3D sketch of shapes. The sketch consists of geometry such as points, lines, arcs and splines. Dimensions are added to the sketch to define the size and location of the geometry. This sketch is then extruded or cut to add

or remove material from the part. SolidWorks is a solid modeler, and utilizes a parametric feature-based approach. This parametric nature means that the dimensions and relations drive the geometry, not the other way around.

The dimensions in the sketch can be controlled independently, or by relationships to these parameters inside or outside of the sketch. Parameters refer to constraints whose values determine the shape or geometry of the model or assembly.

Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. In an assembly, the analog to sketch relations are mates.

Just as sketch relations define conditions such as tangency, parallelism, and concentricity with respect to sketch geometry, assembly mates define equivalent relations with respect to the individual parts or components, allowing the easy construction of assemblies.

Finally, drawings can be created either from parts or assemblies. Views are automatically generated from the solid model, and notes, dimensions and tolerances can then be easily added to the drawing as needed.

III.4 Desired features

To achieve what we expect, our machine:

- Must fit any palm tree whatever is his diameter, or at least cover a large diameter values,
- Must be able to climb to any high,
- Must be able to cut a desired frond,
- Must give a clear view to the operator,
- Must be able to move down when the task is finished,
- Should be easy to handle with and operate,
- Should be light weigh

III.5 3D elements modeling

The machine consists of three main similar sections to facilitate disassembly and installation. Each section is connected to the two others to form a kind of a cylindrical structure which will support the climbing mechanisms and the cutting tool.

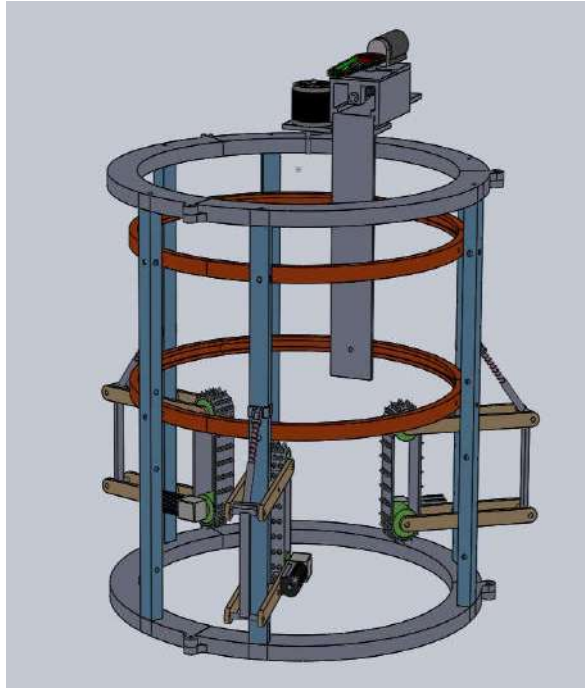


Figure III-1: Movement mechanism

Each one of the three climbing mechanisms has a main support frame with two wheels guiding a rubber chain derived by an electrical motor.

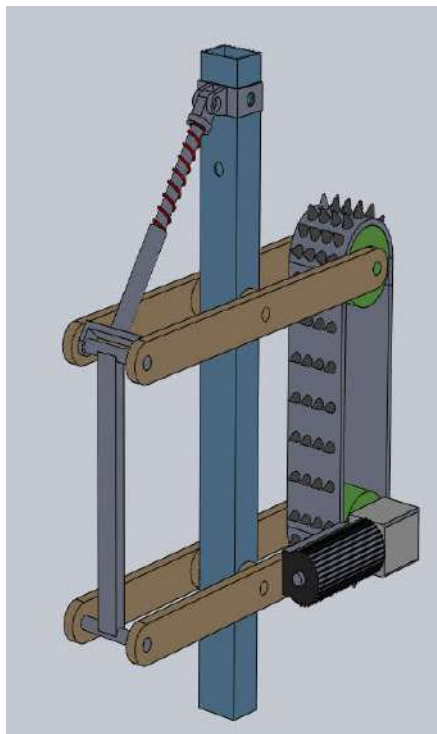


Figure III-2: Wheels-chain system

The main section of the cutting head is a cutting mechanism at the upper end of a pivoting cutting arm to cut Wrapping and/or fronds from the trunk. A tent assembly directs debris directly down ward to prevent injury or damage and ease cleanup.



Figure III-3: The cutting blade [13]

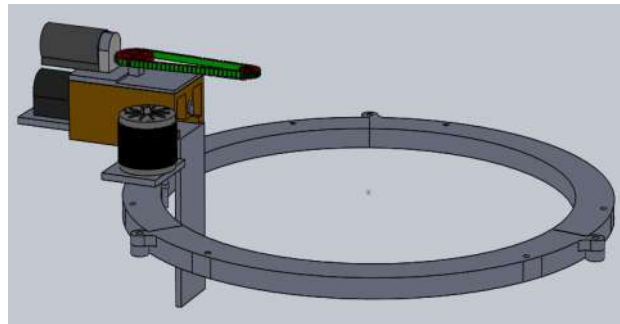
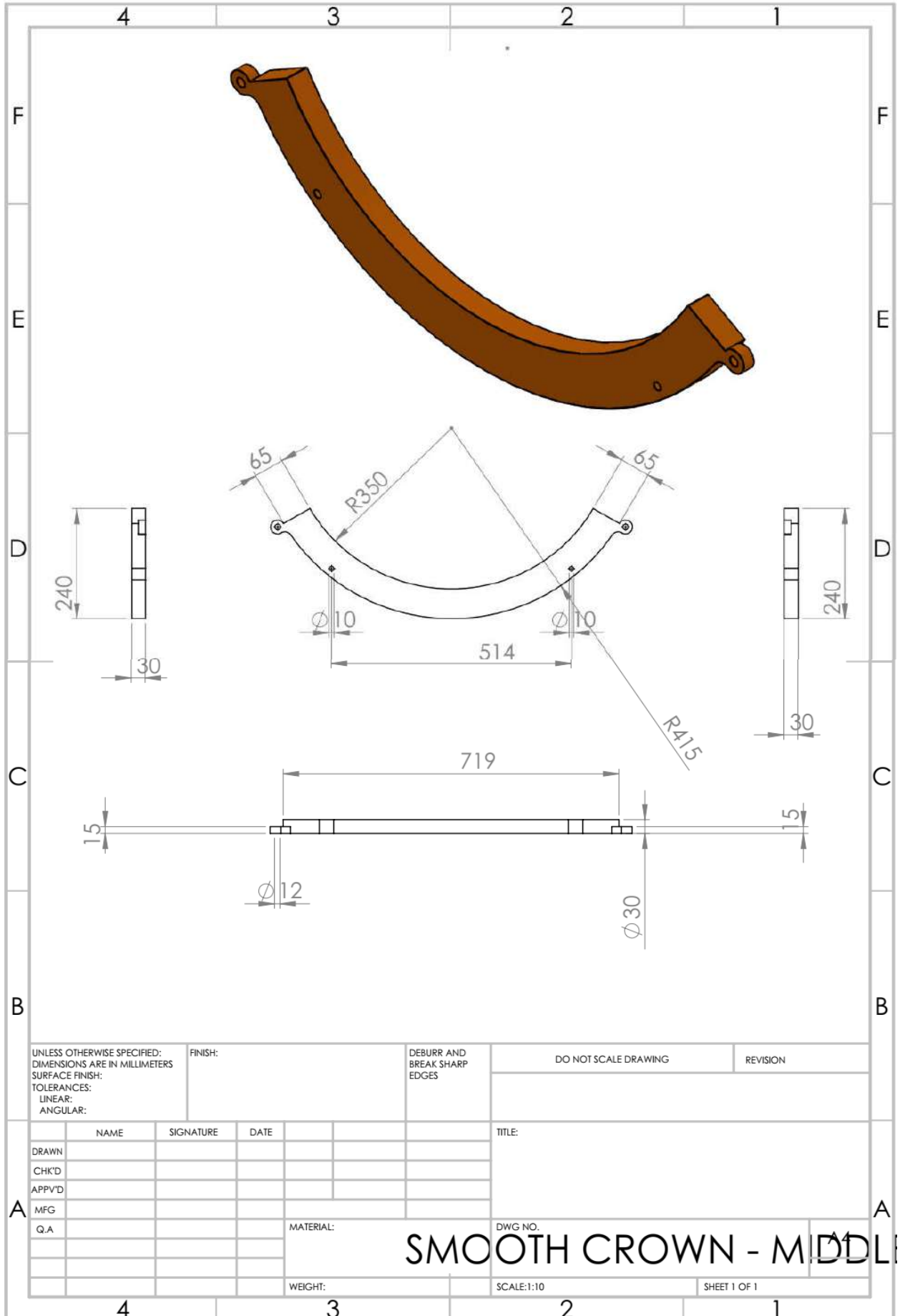
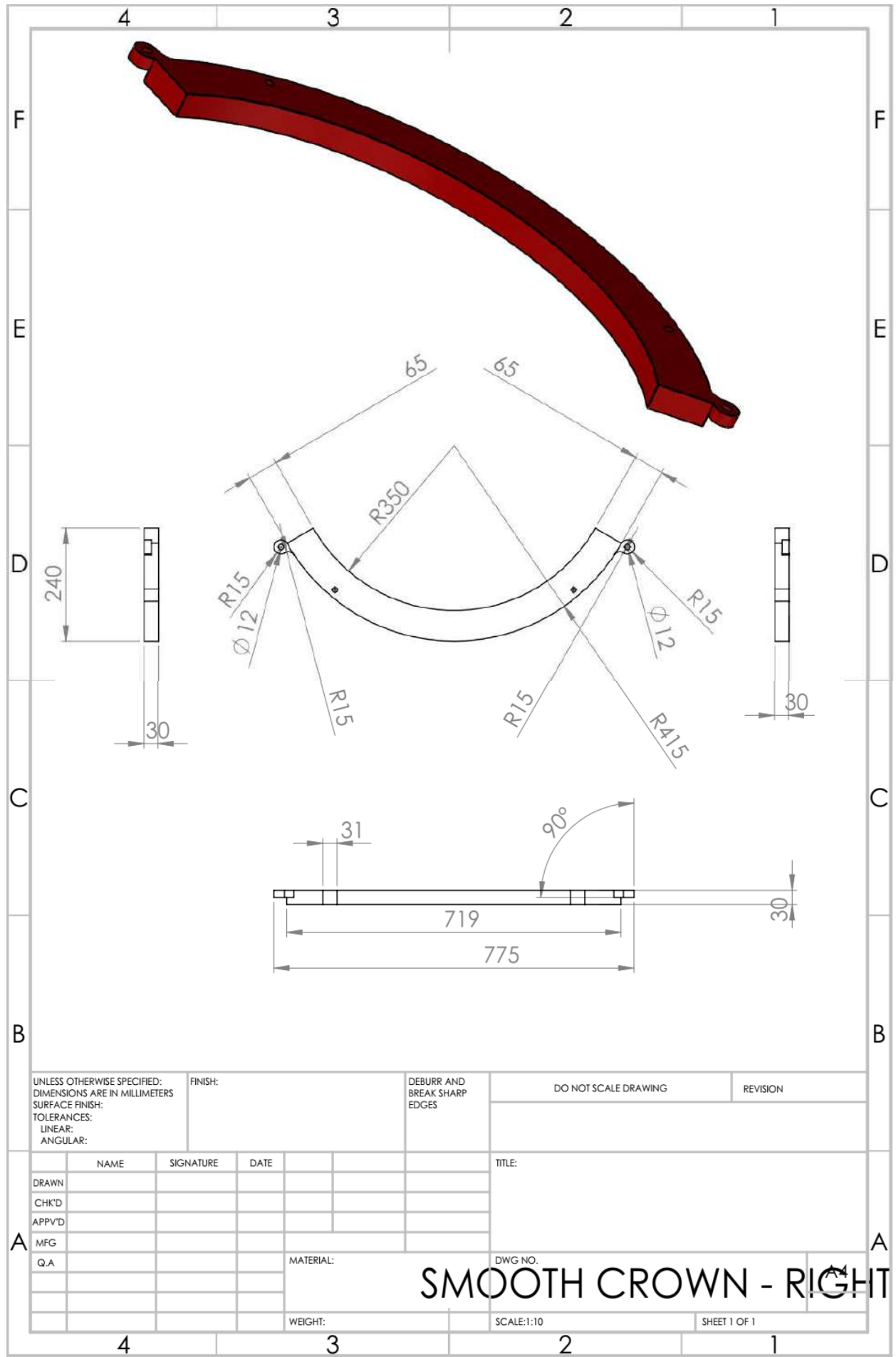
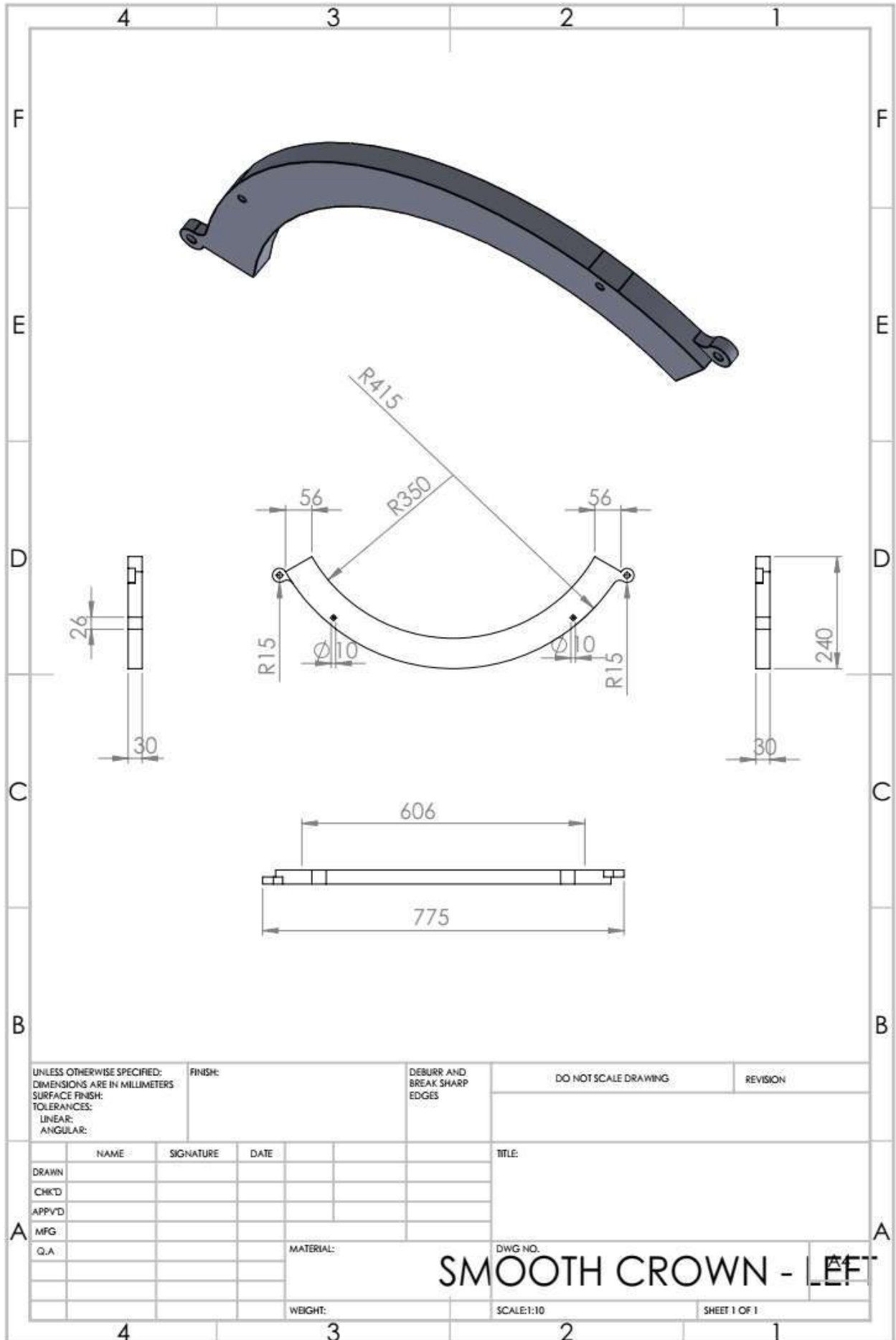


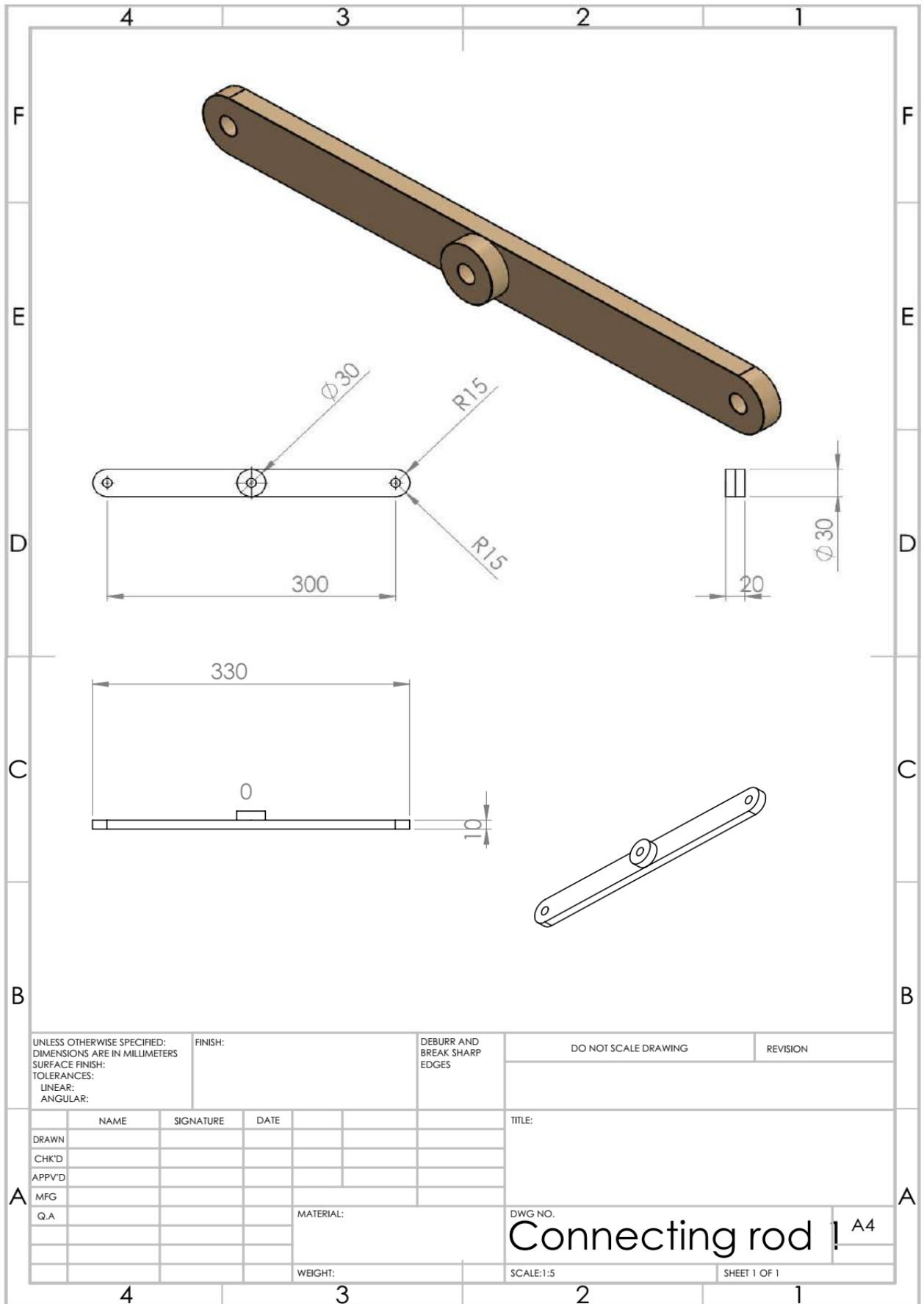
Figure III-4: Cutter disc drive

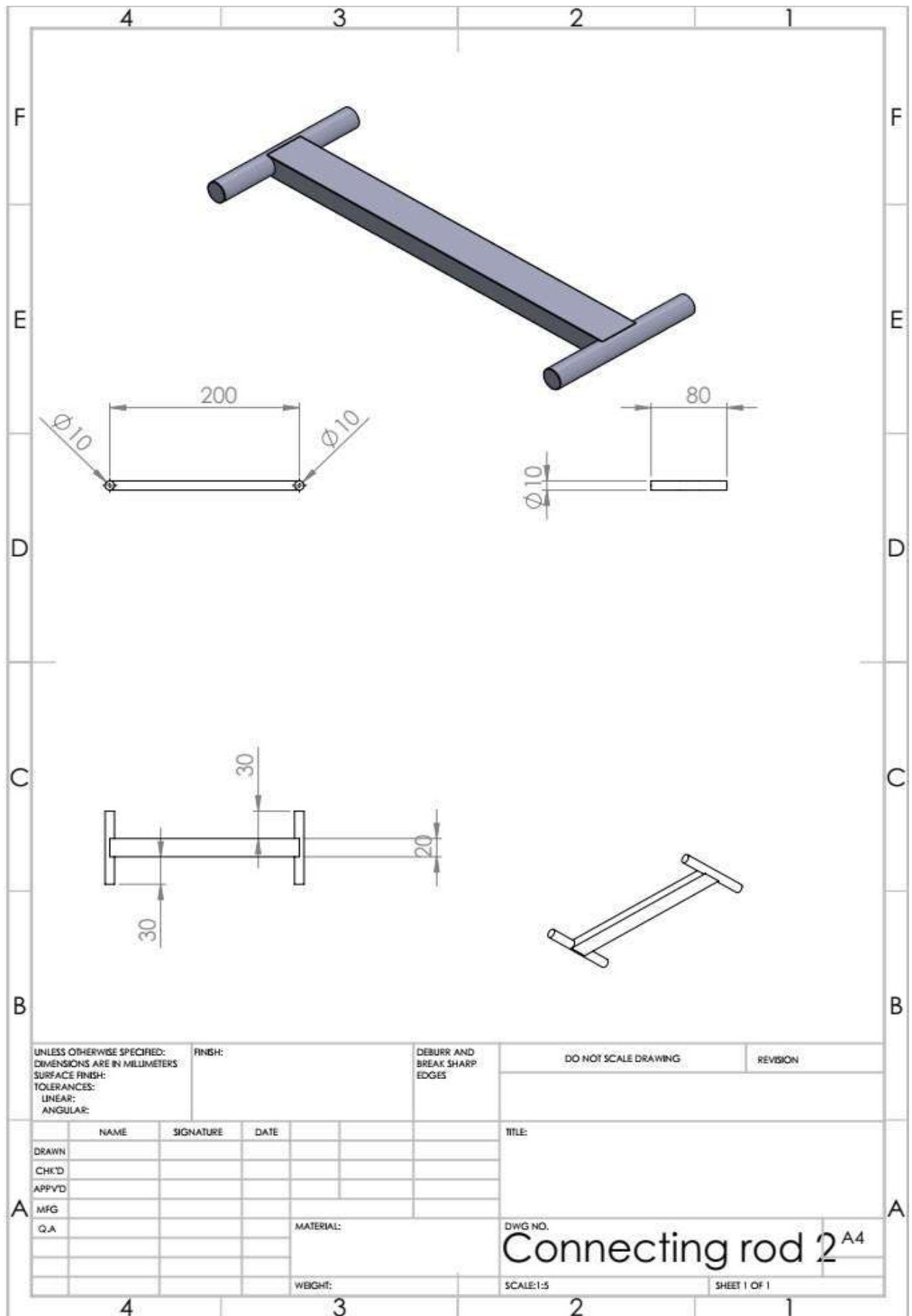
In the following gallery we will show the basic parts of the pruning machine to fully understand how the machine works.

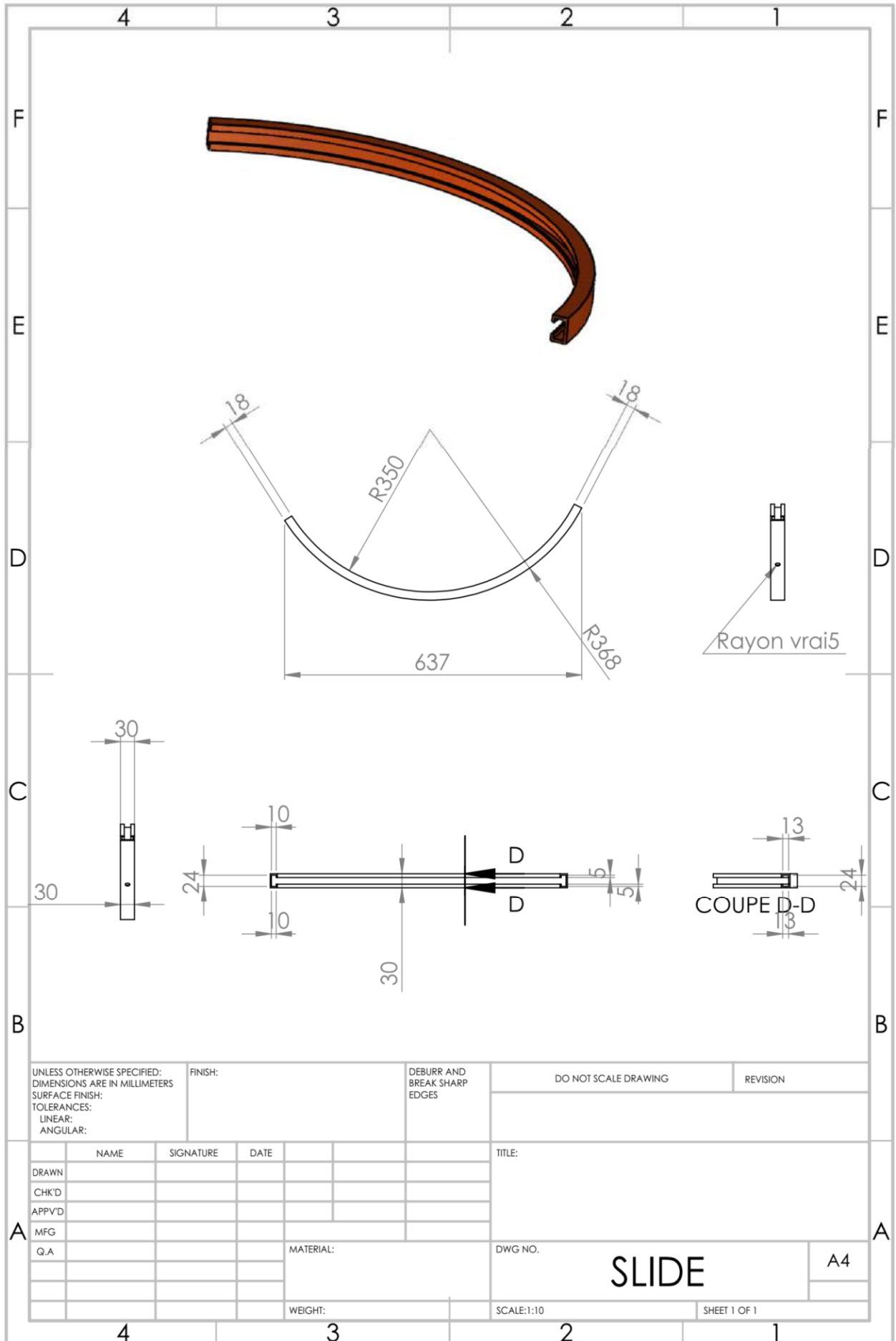


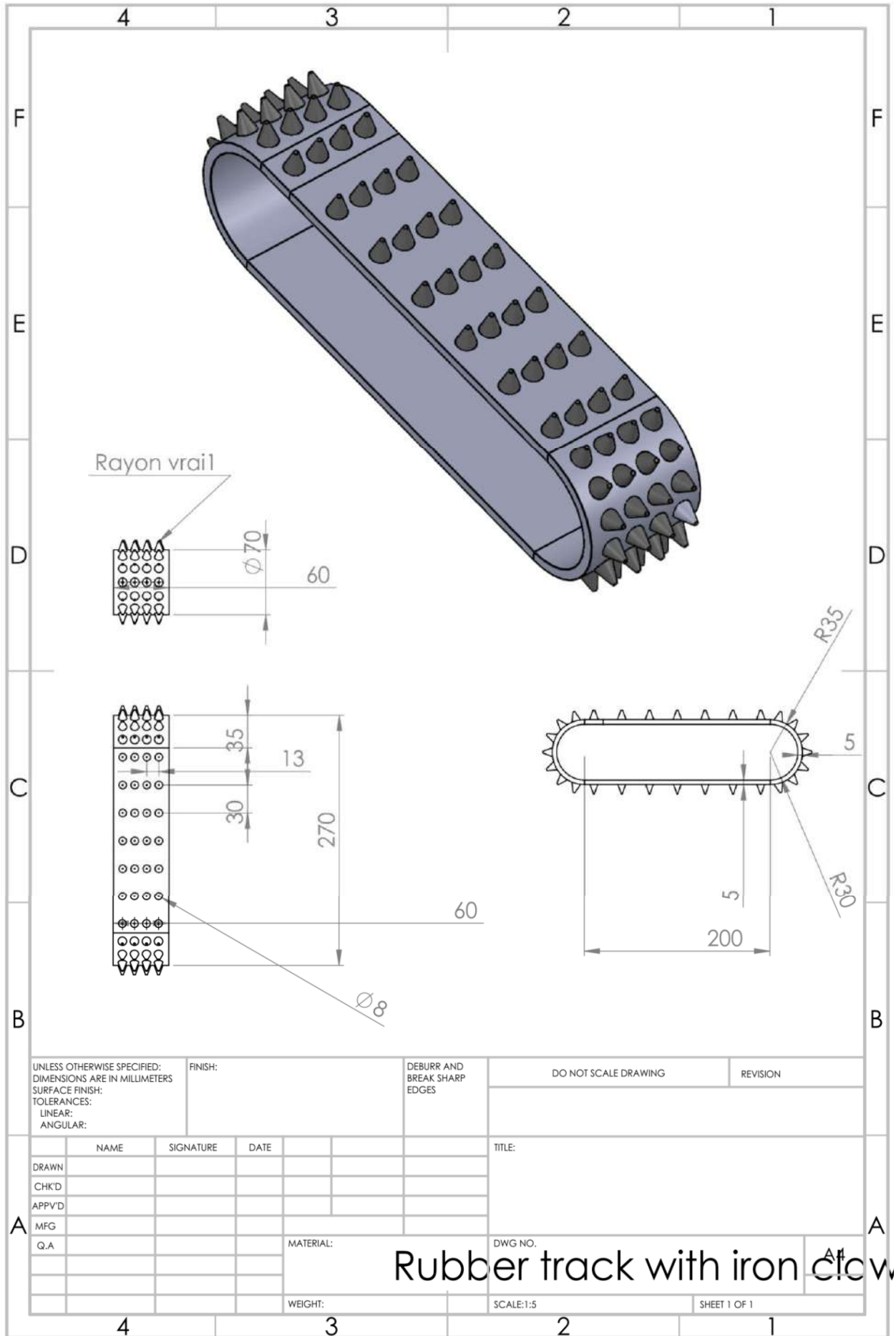


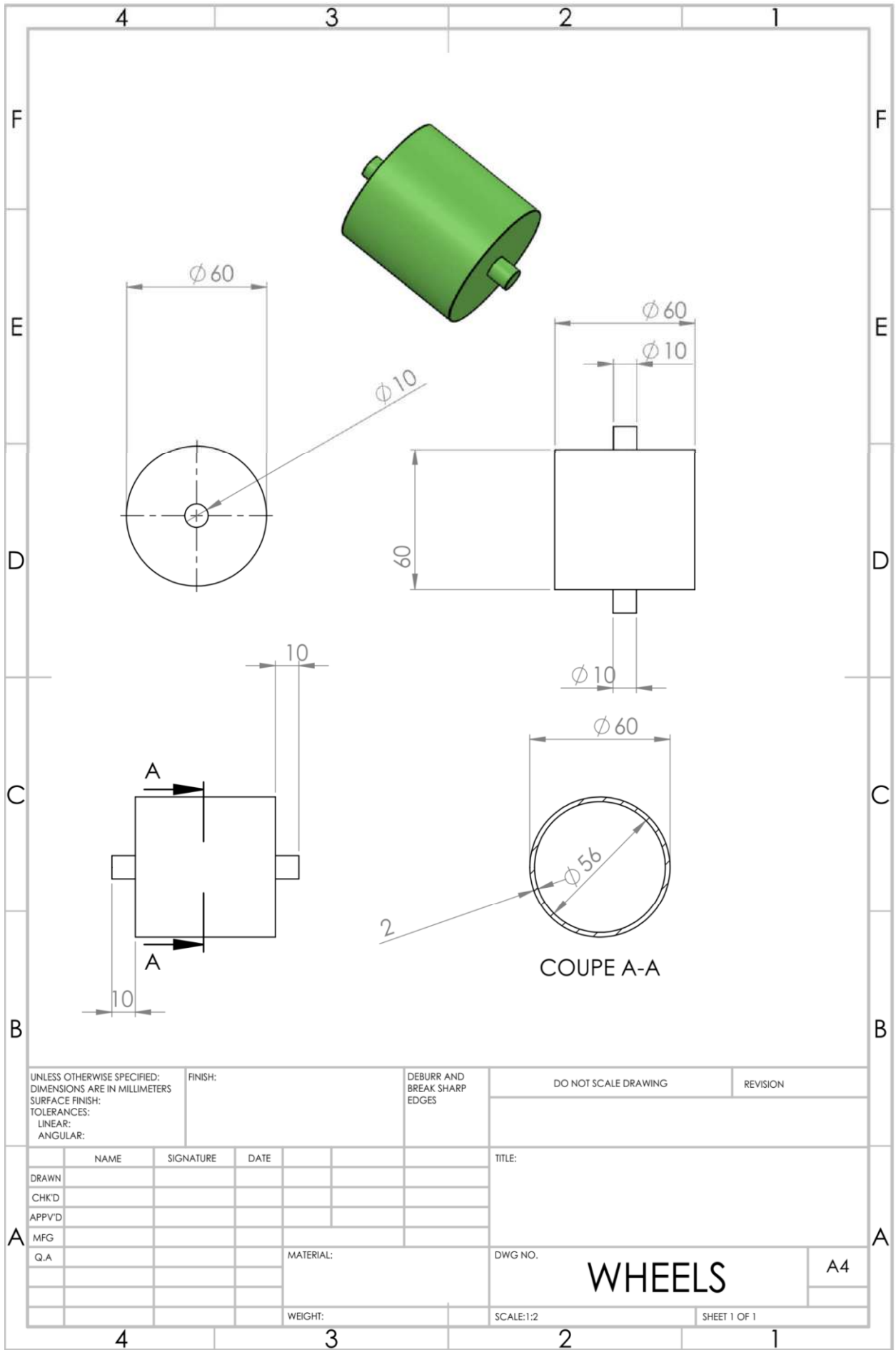












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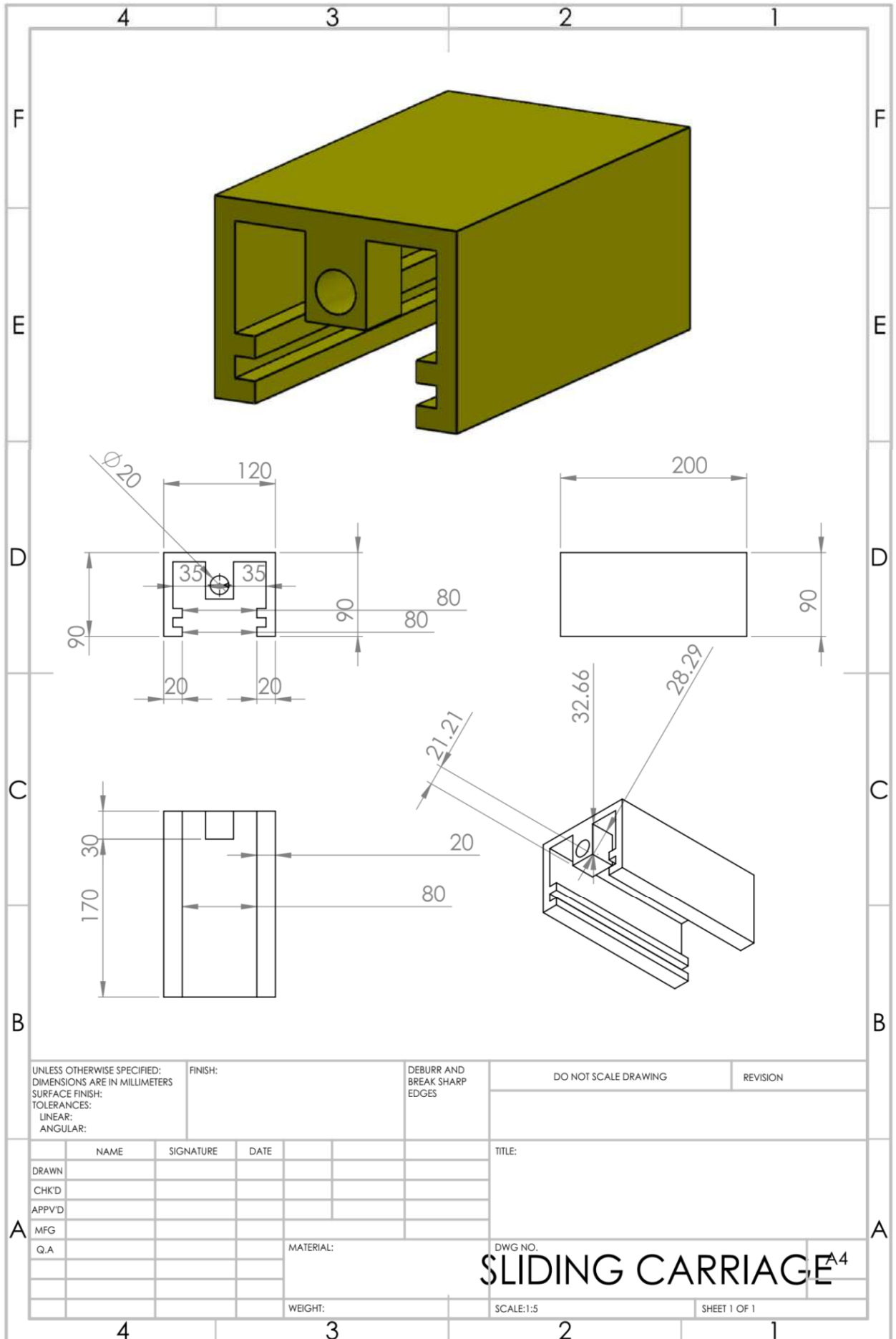
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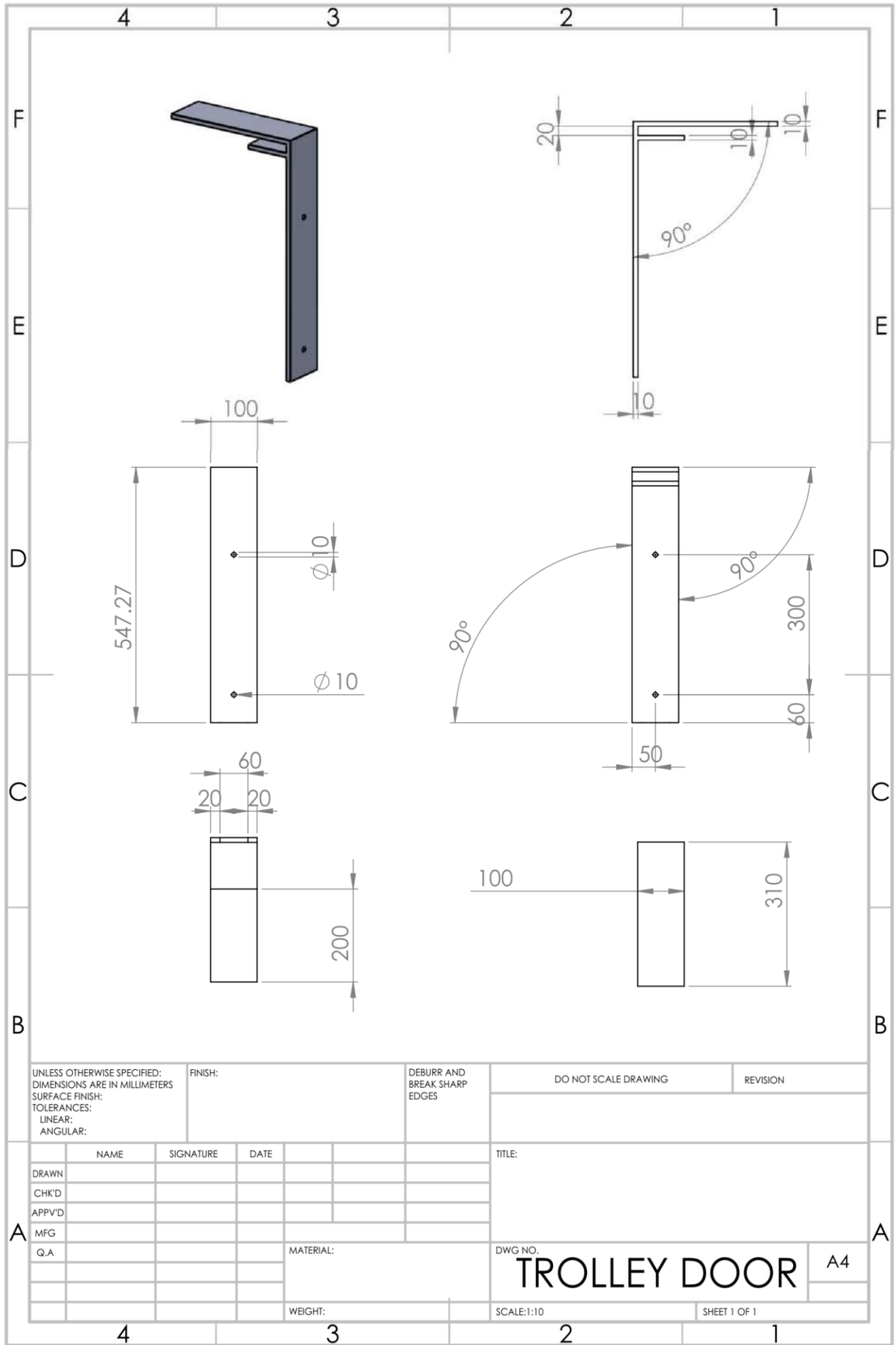
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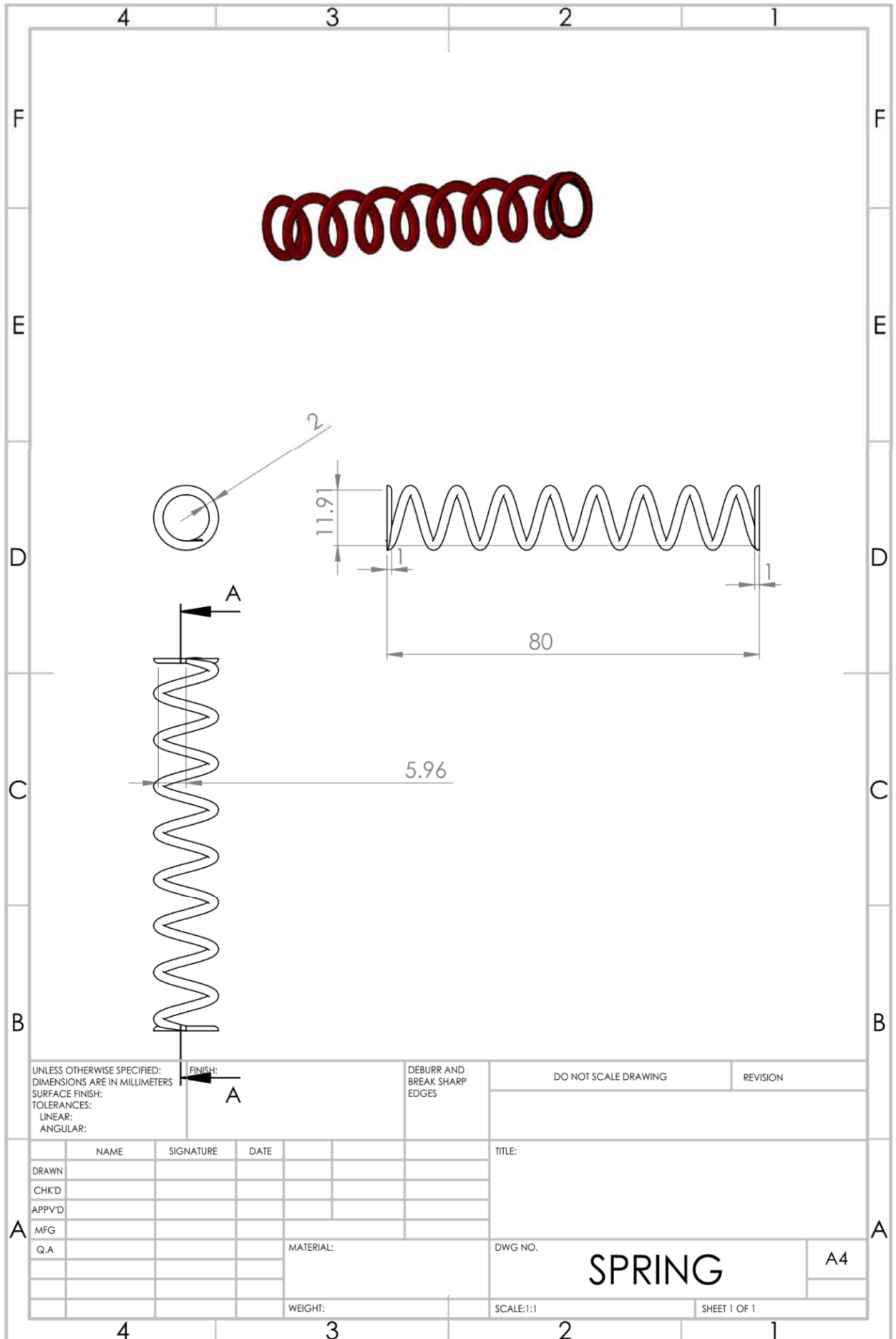
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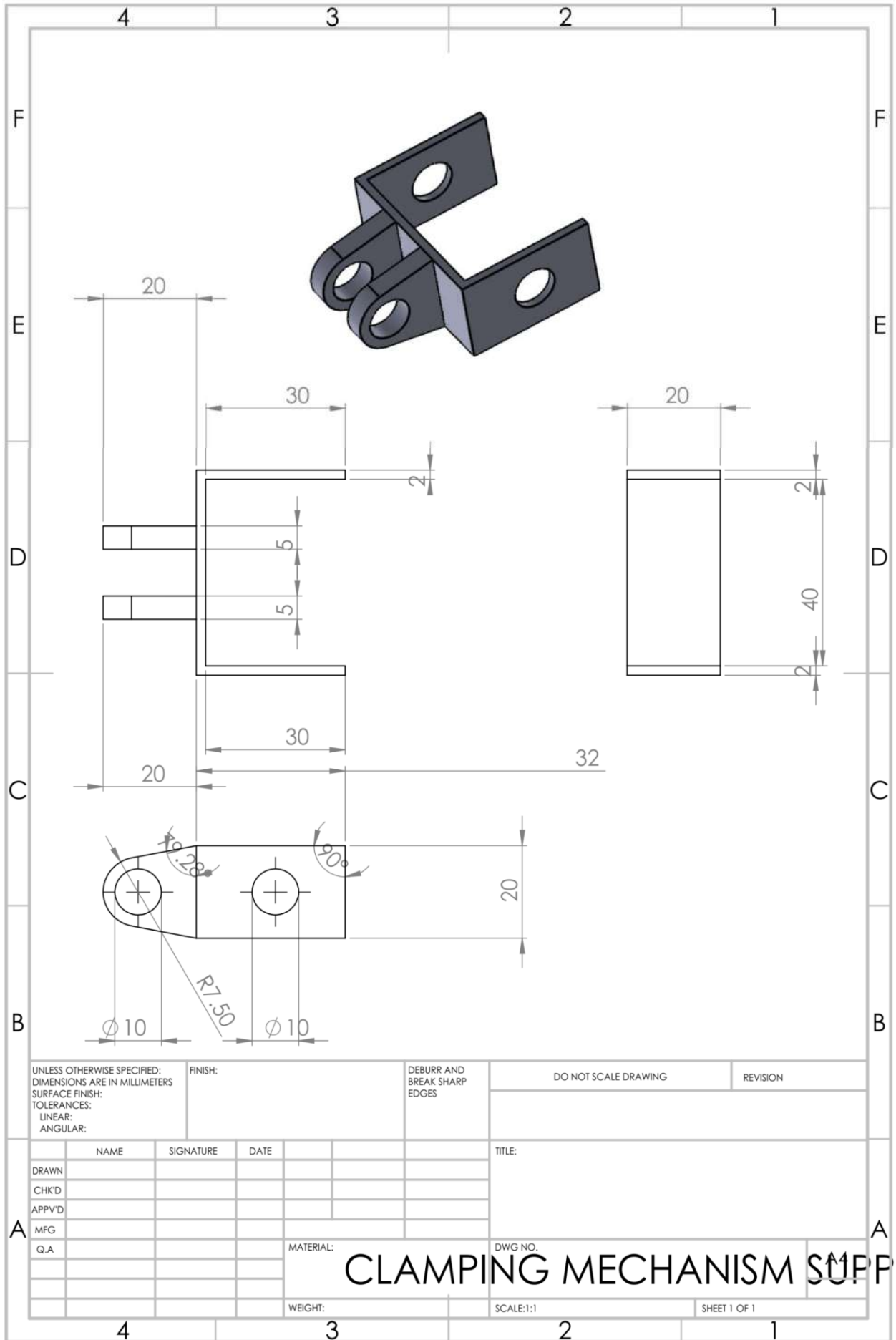
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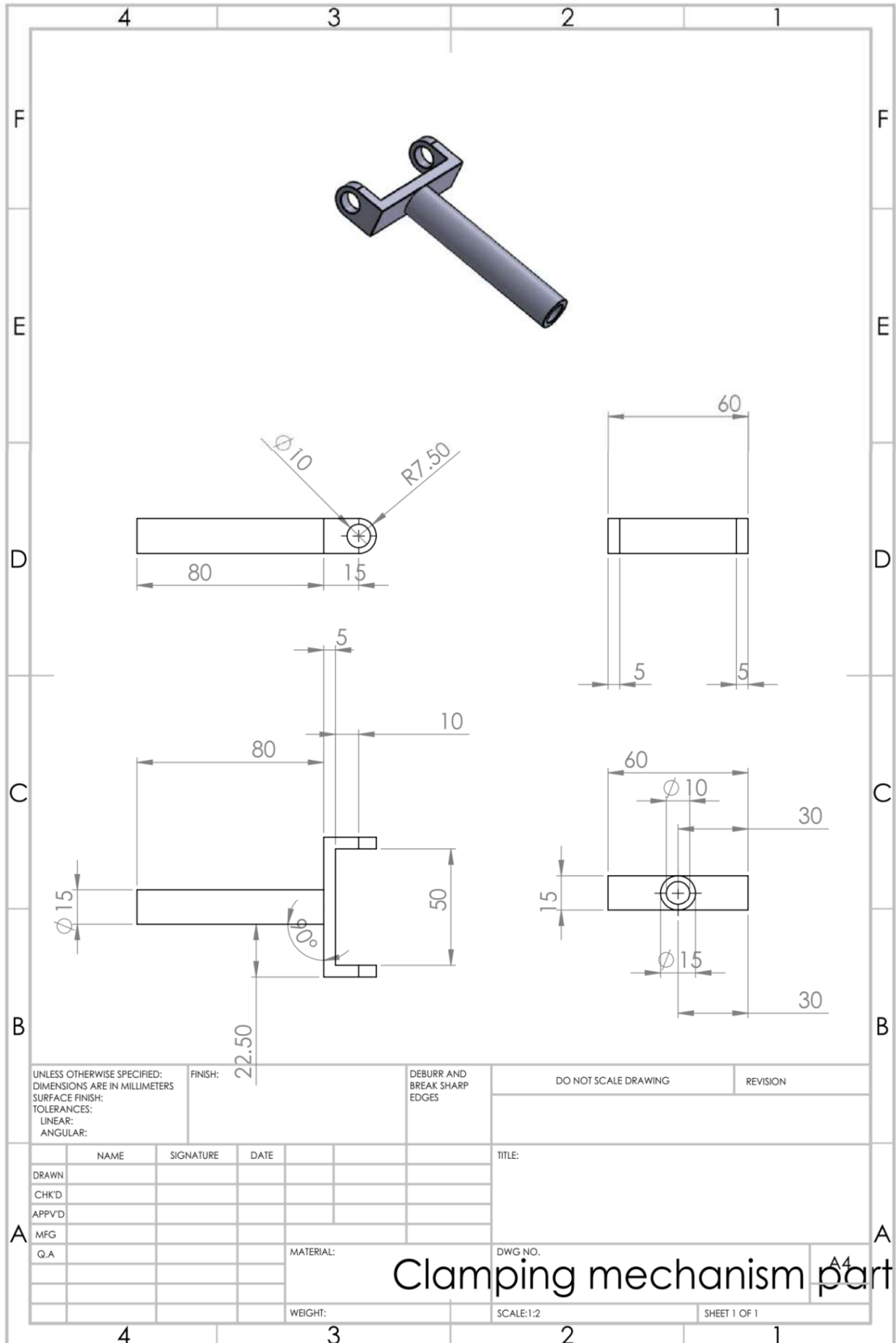
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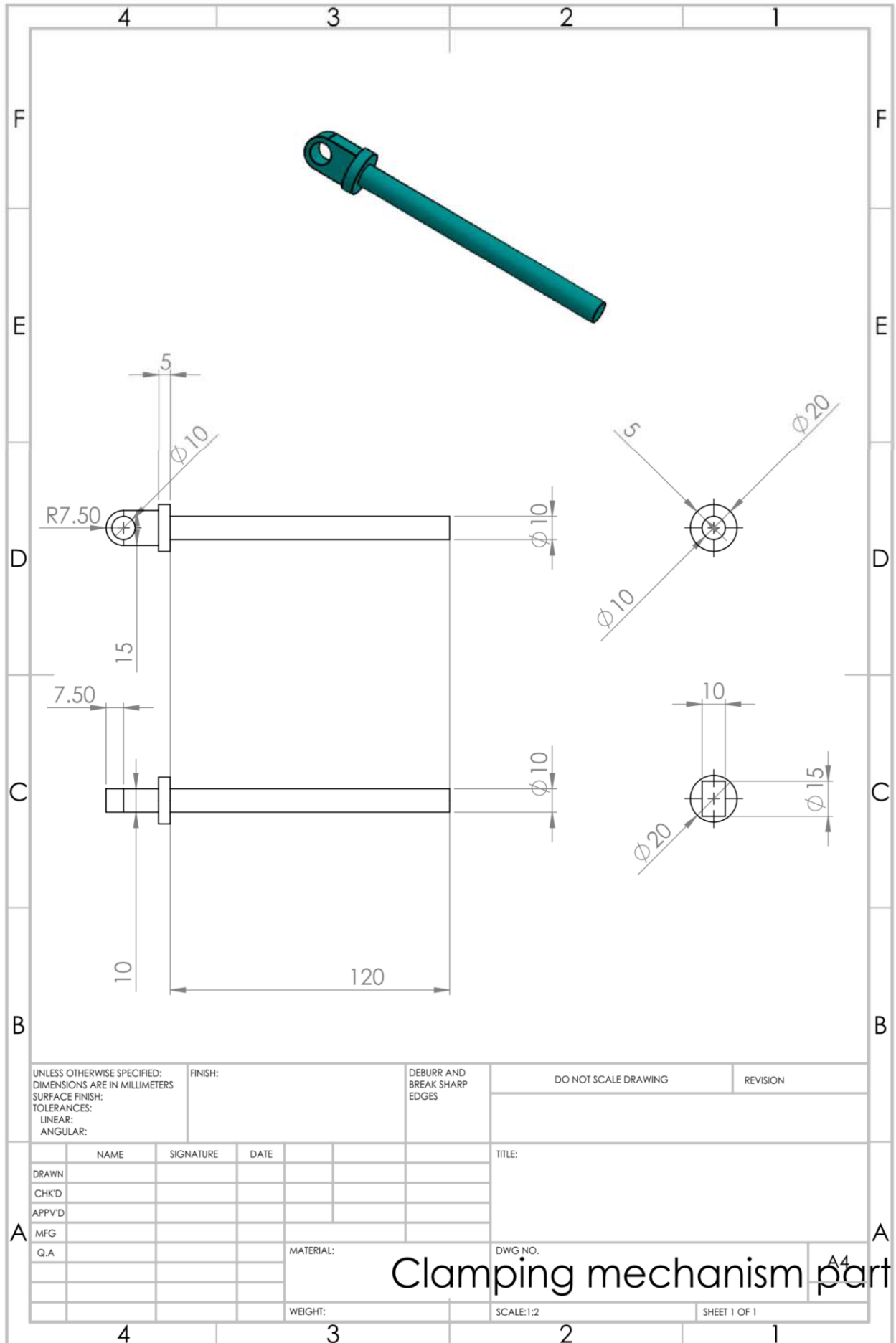
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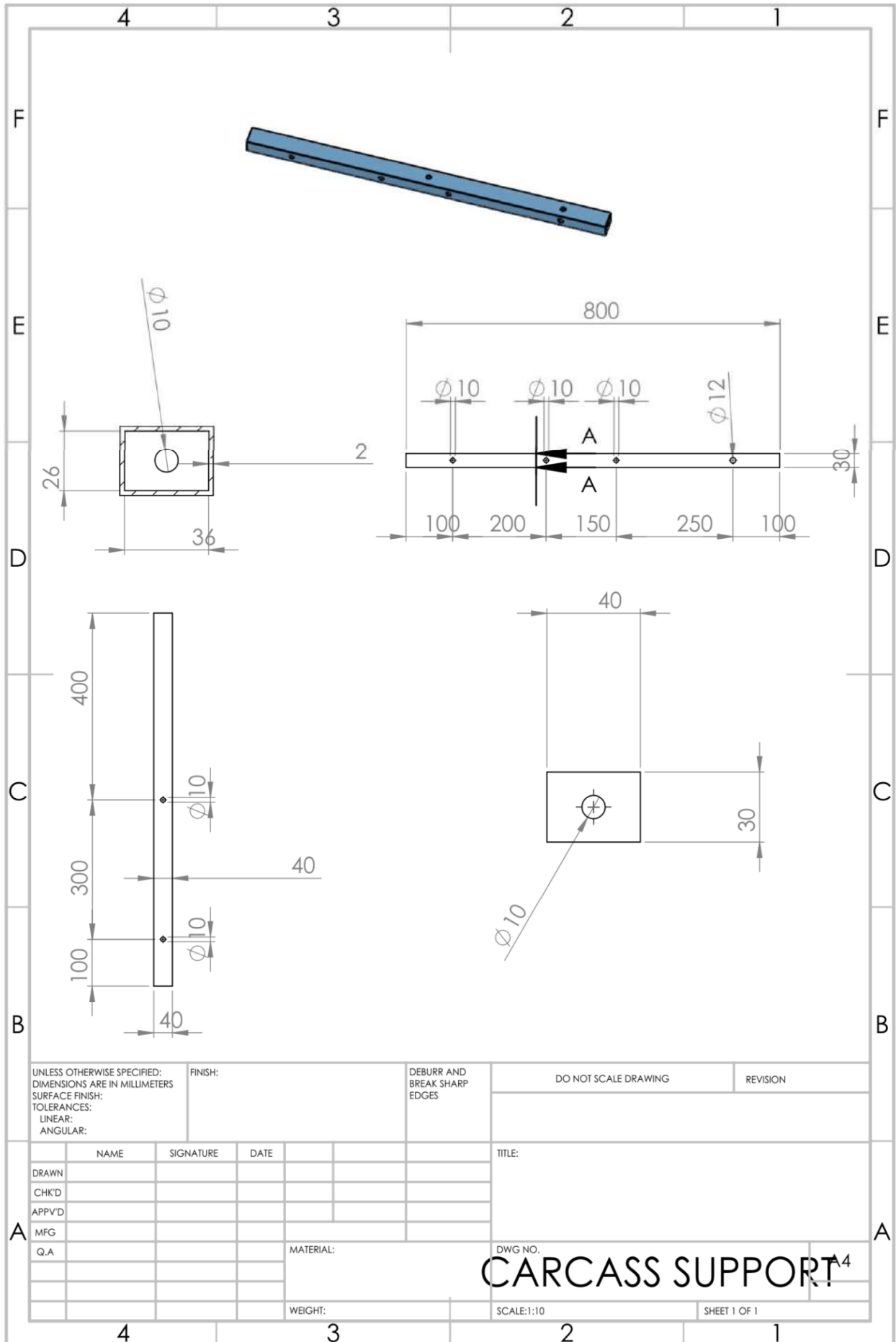
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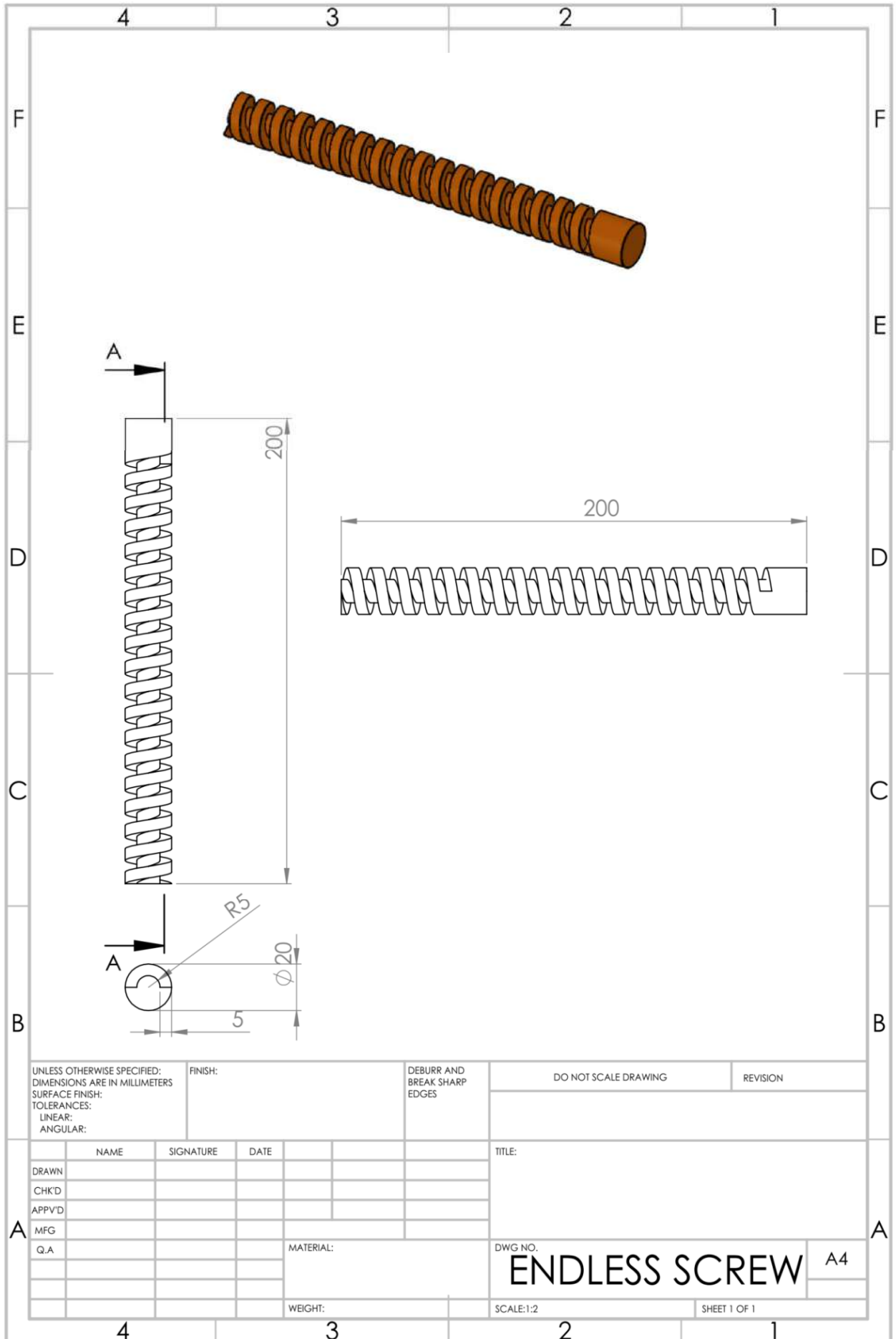
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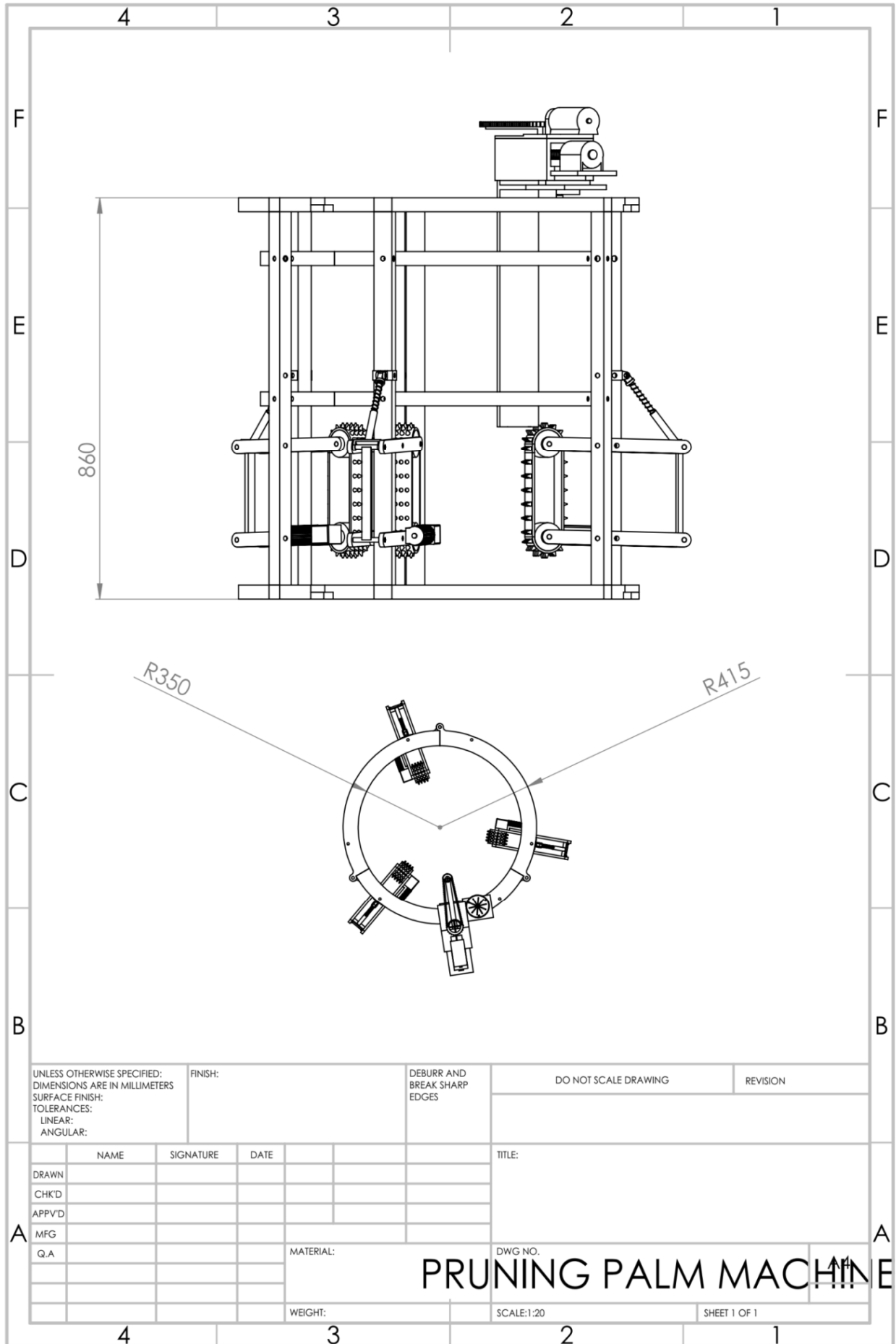
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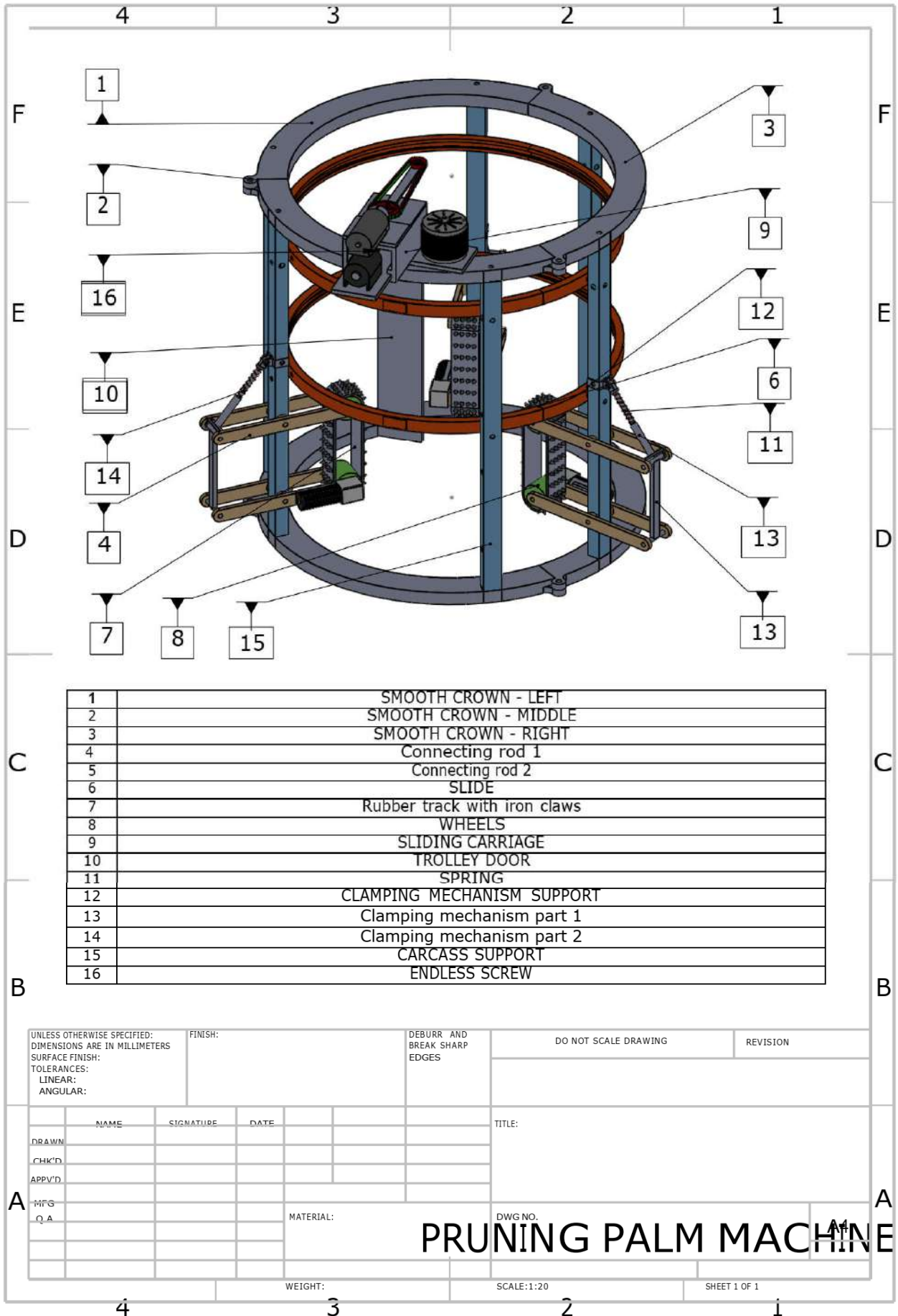
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Conclusion

The work done in this memorandum is related to the study and design of a pruning machine suitable for fruitful palm trees, where the purpose of this design is to facilitate the matter for farmers by saving time and effort .

This is to confirm that the date palm is an important agricultural wealth in the southeast of Algeria .Where we saw that is necessary to try to develop palm cultivation.

In this work, we tried to shed light on the problem of palm care, especially in the pruning aspect, and to present a look at the automated climbing palm pruner as the best example for a solution for our problematic .

Our design focuses on providing solutions that help us reduce the consumption of time and effort during pruning.

Despite our efforts to conduct this study, this work constitutes an additional contribution .in the field of design, so it is still open to criticism. We also accept any suggestion to improve this machine.

In the end, we hope that this design will be the subject of manufacture, and that it will be soon available for labor.

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