الـملاحق

6-4-1 الـمعادلات الـتي تـم استخدامها فـي تـصميم وتـحليل الـتروس:

```
m=4;                                % module
p=4000;                          %power of motor in watt
segma_o=196;                    %allowable static stress
segma_es=1050;                      %
segma_e=168;                        %
 Ep=200e3;                          %young`s modulus for
                 the material of the pinion in N/mm^2
 Eg=200e3;                          %young`s modulus for
                   the material of the gear in N/mm^2
theta=20
thetar=theta*pi/180
    k=2.69341;                          %factor depending
                              upon the form of the teeth
D=m*T*10^-3 ;
disp('-----------------------')
v=(pi*D*n)/60              %pitch line velocity in m/s
Cv=3/(3+v)                          %velocity factor
     segma_w=segma_o*Cv                  %The permissible
                                          working stress


Q=((2*Tg)/(Tg+Tp))                  %Ratio factor
```

```
disp('------------------------')

D                %Diameter of the pitch circle

y=0.154-(0.912/T        %half thickness of the teeth
Wt=p/v          %tangential load action at the tooth
a=4
dm=5
b=Wt/(pi*m*y*segma_w)%face of width  of gears in mm

Pc=pi*m                      %circular pitch
disp('------------------------')              %
Torque=p*60/(2*pi*n)
c=b        %A deformation or dynamic factor in N/mm
WI=(((21*v)*(B*c+Wt))/(21*v*sqrt(B*c+Wt)))
%increment load due to dinamic action
WD=Wt+WI                %total dinamic load in newton
Wn=Wt/cos(thetar)
WR=sqrt(Wn^2+Wt^2 +2*Wn*Wt*cos(thetar))
Ws=segma_e*b*pi*m*y
%Static tooth load or beam strength of the tooth
wg=0.00118*T*B*(m^2)
Ww=D*B*Q*k*10^3
%Maximum or limiting load for wear in newtons
```

6-4-2 نص برنامج ماتلاب الذي يوضح التروس المعشقة عند السرعة المعينة:

```
clear
clc
T1=20;
T1_dash=40;
T2=25;
T2_dash=35;
T3=45;
T3_dash=45;
T4=30;
T4_dash=60;
T5=18;
T5_dash=72;
T6=60;
T6_dash=30;
T7=18;
T7_dash=72;
N1=900;
T11=T1/T1_dash;
T22=T2/T2_dash;
T33=T3/T3_dash;
T44=T4/T4_dash;
```

```
T55=T5/T5_dash;
T66=T6/T6_dash;
T77=T7/T7_dash;
for i=1:13
N=input('    enter the speed you need out  N=    ')
N136=N1*T11*T33*T66;
N137=N1*T11*T33*T77;
N156=N1*T11*T55*T66;
N157=N1*T11*T55*T77;
N146=N1*T11*T44*T66;
N147=N1*T11*T44*T77;
N236=N1*T22*T33*T66;
N237=N1*T22*T33*T77;
N246=N1*T22*T44*T66;
N247=N1*T22*T44*T77;
N256=N1*T22*T55*T66;
N257=N1*T22*T55*T77;
%%%% the tolerance = +or-5 rpm
if N<=905&&N>=895
   disp('     T1&T1_dash  and  T3&T3_dash  and
T6&T6_dash  '  )
   fprintf('------> the exactly speed = %g
rpm',N136)
   disp('                                      ')
elseif  N<=117&&N>=107
    disp('     T1&T1_dash  and  T3&T3_dash  and
T7&T7_dash'    )
```

```
fprintf('------> the exactly speed = %g rpm',N137)
   disp('                                          ')
elseif  N<=230&&N>=220
        disp('     T1&T1_dash  and  T5&T5_dash  and
T6&T6_dash'    )
    fprintf('------> the exactly speed = %g
rpm',N156)
   disp('                                          ')
elseif  N<=33&&N>=23
disp('     T1&T1_dash  and  T5&T5_dash  and
T7&T7_dash'    )
fprintf('------> the exactly speed = %g rpm',N157)
   disp('                                          ')
elseif  N<=455&&N>=395
    disp('     T1&T1_dash  and  T4&T4_dash  and
T6&T6_dash'    )
    fprintf('------> the exactly speed = %g
rpm',N146)
   disp('                                          ')
elseif  N<=61&&N>=51
        disp('     T1&T1_dash  and  T4&T4_dash  and
T7&T7_dash'    )
        fprintf('------> the exactly speed = %g
rpm',N147)
   disp('                                          ')

elseif  N<=1255&&N>=1245
```

```
    disp('     T2&T2_dash  and  T3&T3_dash  and
T6&T6_dash'    )
            fprintf('------> the exactly speed = %g
rpm',N236)
   disp('                                        ')
elseif  N<=165&&N>=155
    disp('     T2&T2_dash  and  T3&T3_dash  and
T7&T7_dash'    )
    fprintf('------> the exactly speed = %g
rpm',N237)
   disp('                                        ')
elseif  N<=630&&N>=625
    disp('     T2&T2_dash  and  T4&T4_dash  and
T6&T6_dash'    )
   fprintf('------> the exactly speed = %g
rpm',N246)
   disp('                                        ')
elseif  N<=85&&N>=75
    disp('     T2&T2_dash  and  T4&T4_dash  and
T7&T7_dash'    )
  fprintf('------> the exactly speed = %g
rpm',N247)
   disp('                                        ')
elseif  N<=325&&N>=315
    disp('     T2&T2_dash  and  T5&T5_dash  and
T6&T6_dash'    )
```

```
    fprintf('------> the exactly speed = %g
rpm',N256)
   disp('                                        ')
elseif N<=45&&N>=35
    disp('     T2&T2_dash  and  T5&T5_dash  and
T7&T7_dash'    )
    fprintf('------> the exactly speed = %g
rpm',N257)
   disp('                                        ')
else
end

end
```

3-4-6 تحليل وحسابات التروس:

```
clear
clc
% design of gears to lathe machine
T1=20;
T1_dash=40;
T2=25;
T2_dash=35;
T3=45;
T3_dash=45;
T4=30;
T4_dash=60;
T5=18;
T5_dash=72;
T6=60;
T6_dash=30;
T7=18;
T7_dash=72;
N1=900;
T11=T1/T1_dash;
T22=T2/T2_dash;
T33=T3/T3_dash;
T44=T4/T4_dash;
T55=T5/T5_dash;
T66=T6/T6_dash;
T77=T7/T7_dash;
```

```
input('enter the number of gear which you want to
be design example for 1 enter 1 , for 1dash enter
11')
disp('-----------------------------------------
-----------------------')
for x=1:15

g=input('enter the number of gear which you want to
be calculate -------> ')

    if g==1
        disp('this gear has one case')
        T=20
        Tg=40;
        Tp=20;
        B=38;
        n=N1
        gear

    elseif g==11
   disp('this gear has one case')
    T=40
    n=N1*T11
    Tg=40;
        Tp=20;
        B=38;
    gear
```

```
    elseif g==2
        disp('this gear has one case')
        T=25
        B=38;
        Tg=35;
        Tp=25;
        n=N1
       gear
    elseif g==22
            disp('this gear has one case')
        T=35
        B=38;
        n=N1*T22
       Tg=35;
        Tp=25;
        gear

    elseif g==3
        disp('this gear has two cases')
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
           T=45
           B=38;
           n=N1*T11
```

```
            Tg=45;
            Tp=45;
            gear
        elseif x==2
            T=45
            B=38;
            n=N1*T22
            Tg=45;
            Tp=45;
            gear
        end
        end

    elseif g==33
        disp('this gear has two cases')
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
            T=45
            B=38;
            n=N1*T11*T33
           Tg=45;
            Tp=45;
            gear
        elseif x==2
            T=45
```

```
            B=38;
            n=N1*T22*T33
            Tg=45;
            Tp=45;
            gear
        end
        end

    elseif g==4
        disp('this gear has two cases')
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
            T=30
            B=38;
            n=N1*T11
            Tg=60;
            Tp=30;
            gear
        elseif x==2
            T=30
            Tg=60;
            B=38;
            Tp=30;
            n=N1*T22
            gear
```

```
        end
        end

    elseif g==44
        disp('this gear has two cases')
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
           T=60
           B=38;
           n=N1*T11*T44
           Tg=60;
           Tp=30;
           gear
        elseif x==2
           T=60
           n=N1*T22*T44
           Tg=60;
           Tp=30;
           B=38;
           gear
        end
        end

    elseif g==5
        disp('this gear has two cases')
```

```
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
           T=18
           B=38;
           Tg=72;
           Tp=18;
           n=N1*T11
           gear
        elseif x==2
           T=18
           B=38;
           n=N1*T22
           Tg=72;
           Tp=18;
           gear
        end
        end

    elseif g==55
        disp('this gear has two cases')
        for i=1:2
        x=input('enter the number of gear which
work together 1 or 2 -------> ')
        if x==1
           T=72
```

```
            B=38;
            Tg=72;
            Tp=18;
            n=N1*T11*T55
            gear
        elseif x==2
            T=72
            n=N1*T22*T55
           Tg=72;
           B=38;
            Tp=18;
            gear
        end
        end

    elseif g==6
        disp('this gear has six cases')
        for i=1:6
        x=input('enter the number of gears which
work together [1 3]or[1 4]0r[1 5]or[2 3]or[2 4]0r[2
5] -------> ')
        if x==[1 3]
            T=60
            B=45;
            Tg=30;
            Tp=60;
            n=N1*T11*T33
```

```
    gear
elseif x==[1 4]
    T=60
     B=45;
    n=N1*T11*T44
     Tg=30;
    Tp=60;
    gear
    elseif x==[1 5]
    T=60
     B=45;
    n=N1*T11*T55
     Tg=30;
    Tp=60;
    gear
    elseif x==[2 3]
    T=60
    n=N1*T22*T33
     Tg=30;
      B=45;
    Tp=60;
    gear
    elseif x==[2 4]
    T=60
     B=45;
    n=N1*T22*T44
     Tg=30;
```

```
            Tp=60;
            gear
            elseif x==[2 5]
            T=60
             B=45;
             Tg=30;
            Tp=60;
            n=N1*T22*T55
            gear
        end
        end

    elseif g==66
        disp('this gear has six cases')
        for i=1:6
        x=input('enter the number of gears which
work together [1 3 6]or[1 4 6]0r[1 5 6]or[2 3
6]or[2 4 6]0r[2 5 6] -------> ')
        if x==[1 3 6]
            T=30
             B=45;
            n=N1*T11*T33*T66
             Tg=30;
            Tp=60;
            gear
        elseif x==[1 4 6]
            T=30
```

```
 B=45;
n=N1*T11*T44*T66
 Tg=30;
Tp=60;
gear
elseif x==[1 5 6]
T=30
 B=45;
n=N1*T11*T55*T66
 Tg=30;
Tp=60;
gear
elseif x==[2 3 6]
T=30
 B=45;
n=N1*T22*T33*T66
 Tg=30;
Tp=60;
gear
elseif x==[2 4 6]
T=30
 B=45;
n=N1*T22*T44*T66
 Tg=30;
Tp=60;
gear
elseif x==[2 5 6]
```

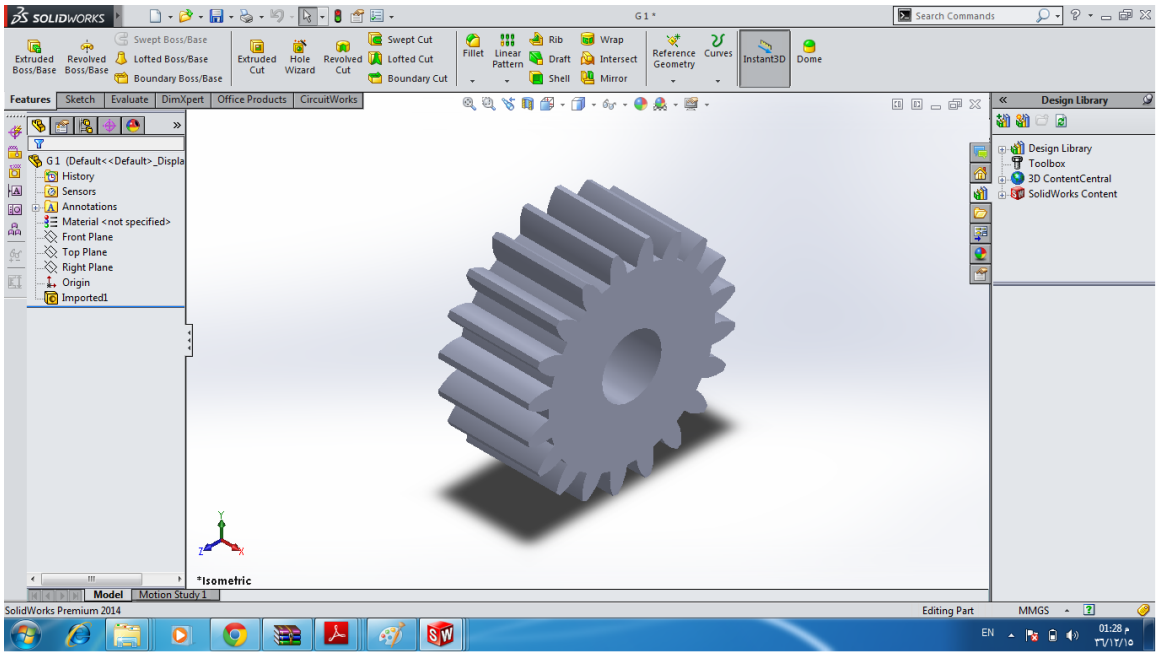
```
            T=30
             B=45;
            n=N1*T22*T55*T66
             Tg=30;
            Tp=60;
            gear
        end
        end
    elseif g==7
        disp('this gear has six cases')
        for i=1:6
        x=input('enter the number of gears which
work together [1 3]or[1 4]0r[1 5]or[2 3]or[2 4]0r[2
5] -------> ')
        if x==[1 3]
            T=18
             B=45;
            n=N1*T11*T33
             Tg=72;
            Tp=18;
            gear
        elseif x==[1 4]
            T=18
             B=45;
            n=N1*T11*T44
            Tg=72;
            Tp=18;
```

```
gear
elseif x==[1 5]
T=18
 B=45;
n=N1*T11*T55
Tg=72;
Tp=18;
gear
elseif x==[2 3]
T=18
 B=45;
n=N1*T22*T33
Tg=72;
Tp=18;
gear
elseif x==[2 4]
T=18
 B=45;
n=N1*T22*T44
Tg=72;
Tp=18;
gear
elseif x==[2 5]
T=18
 B=45;
n=N1*T22*T55
Tg=72;
```

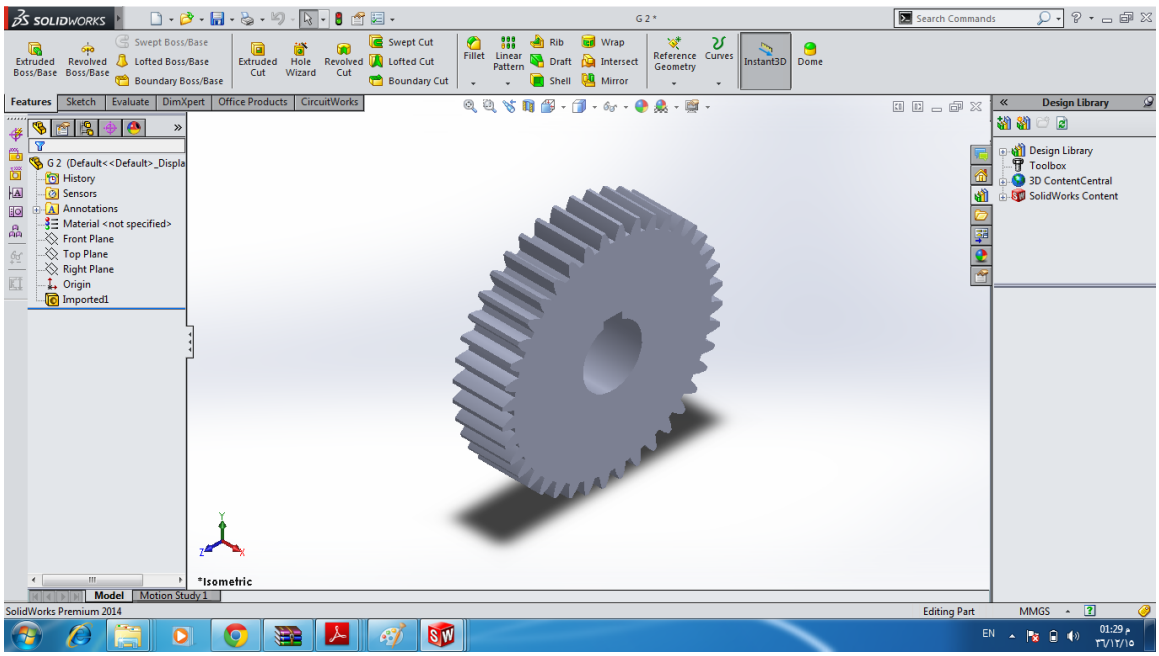
```
            Tp=18;
            gear
        end
        end
    elseif g==77
        disp('this gear has six cases')
        for i=1:6
        x=input('enter the number of gears which
work together [1 3 7]or[1 4 7]or[1 5 7]or[2 3
7]or[2 4 7]or[2 5 7] -------> ')
        if x==[1 3 7]
            T=72
             B=45;
            n=N1*T11*T33*T77
            Tg=72;
            Tp=18;
            gear
        elseif x==[1 4 7]
            T=72
             B=45;
            n=N1*T11*T44*T77
            Tg=72;
            Tp=18;
            gear
            elseif x==[1 5 7]
            T=72
             B=45;
```

```
            n=N1*T11*T55*T77
            Tg=72;
            Tp=18;
            gear
            elseif x==[2 3 7]
            T=72
             B=45;
            n=N1*T22*T33*T77
            Tg=72;
            Tp=18;
            gear
            elseif x==[2 4 7]
            T=72
             B=45;
            n=N1*T22*T44*T77
            Tg=72;
            Tp=18;
            gear
            elseif x==[2 5 7]
            T=72
             B=45;
            n=N1*T22*T55*T77
            Tg=72;
            Tp=18;
            gear
        end
        end
    end
end
```

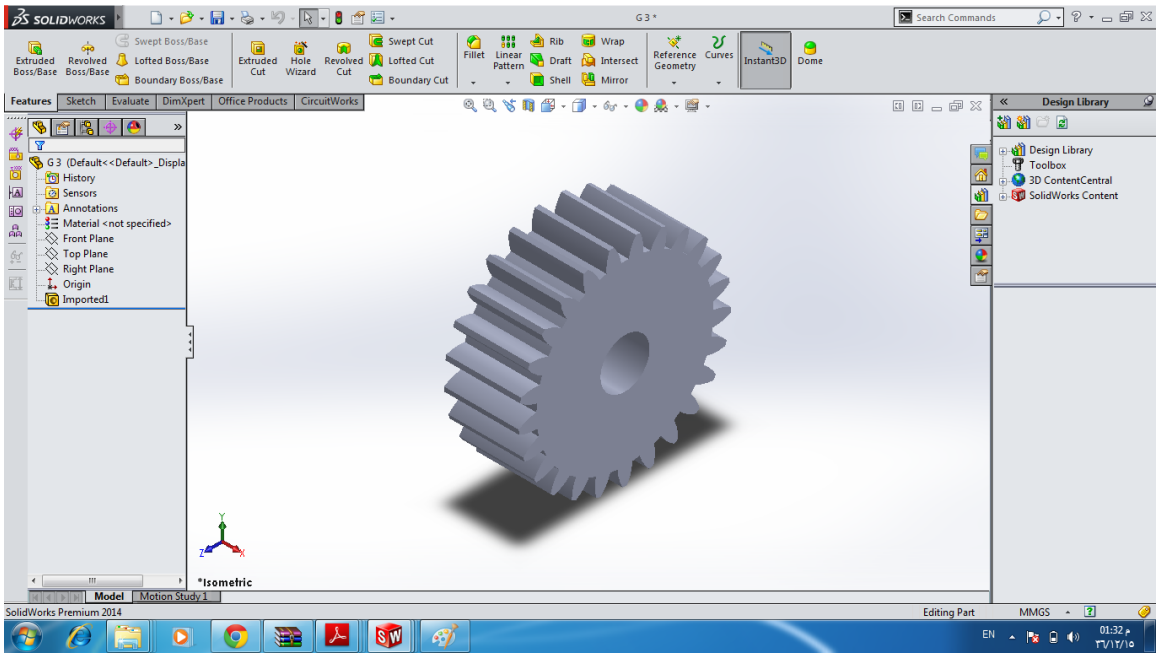
4-4-6 مكونات علبة السرعات التي رسمها بواسطة برنامج (SOLIDWORK2015):



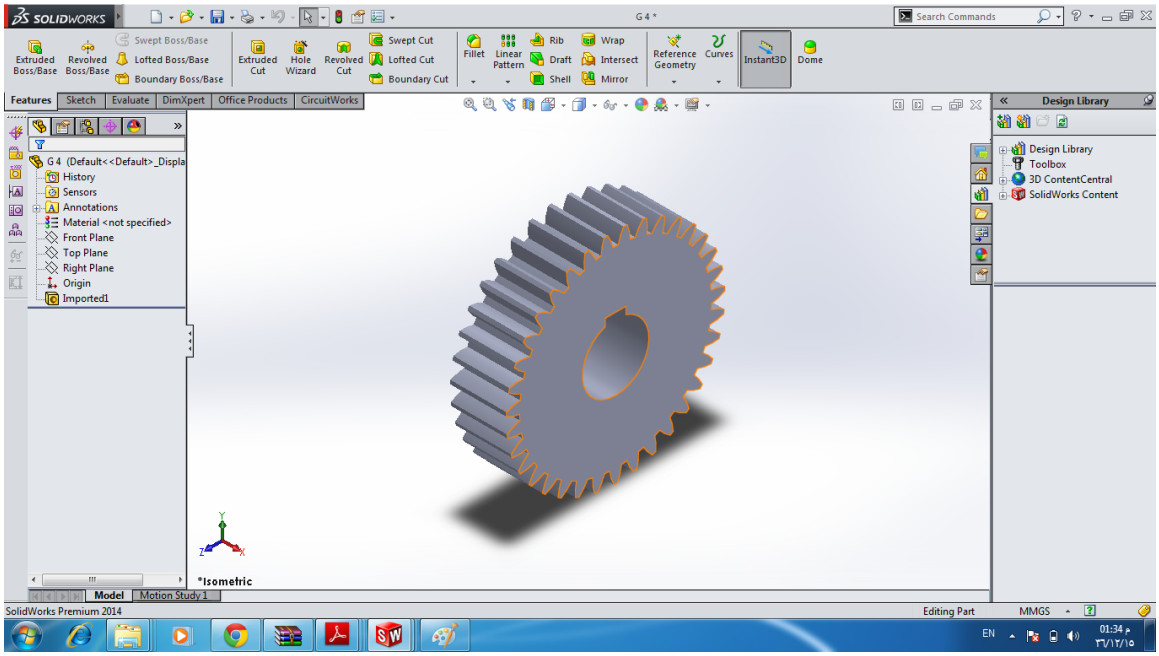
الشكل (6-1) يوضح الرسم ثلاثي الأبعاد للترس الأول



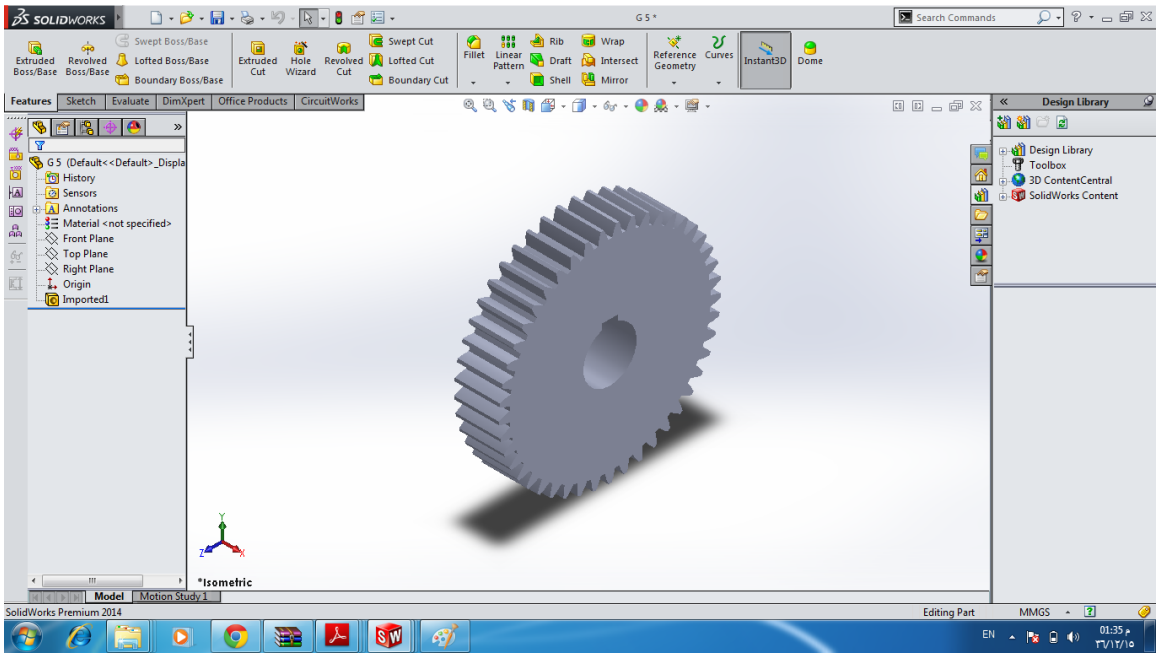
الشكل (6-2) يوضح الرسم ثلاثي الأبعاد للترس الثاني



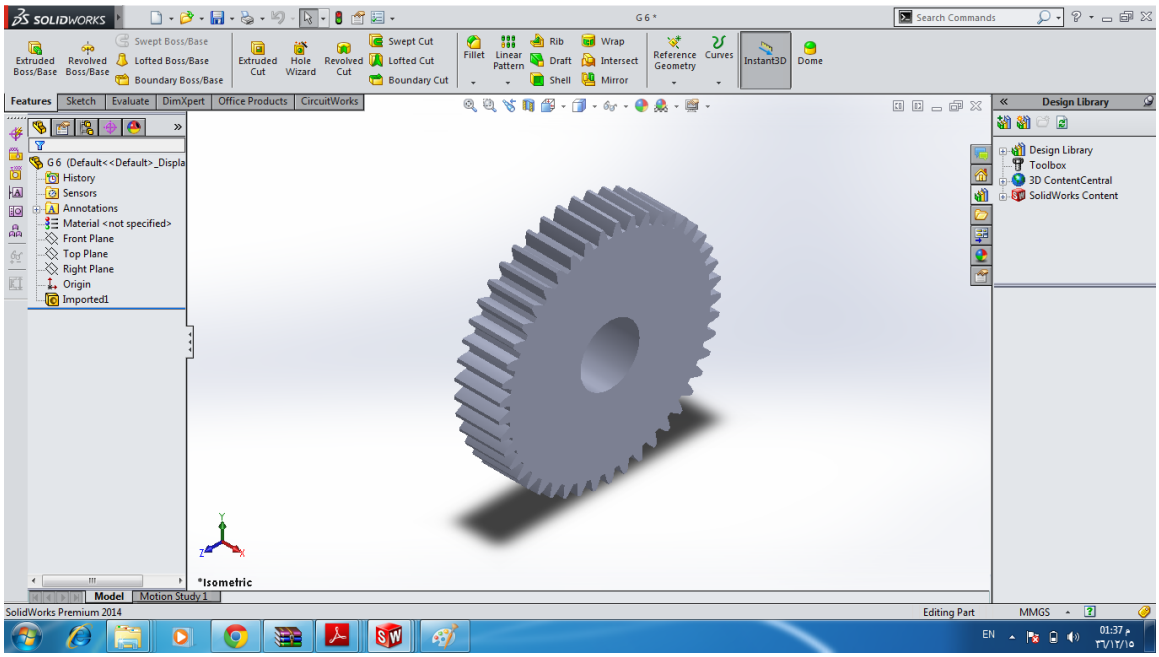
الشكل (6-3) يوضح الرسم ثلاثي الأبعاد للترس الثالث



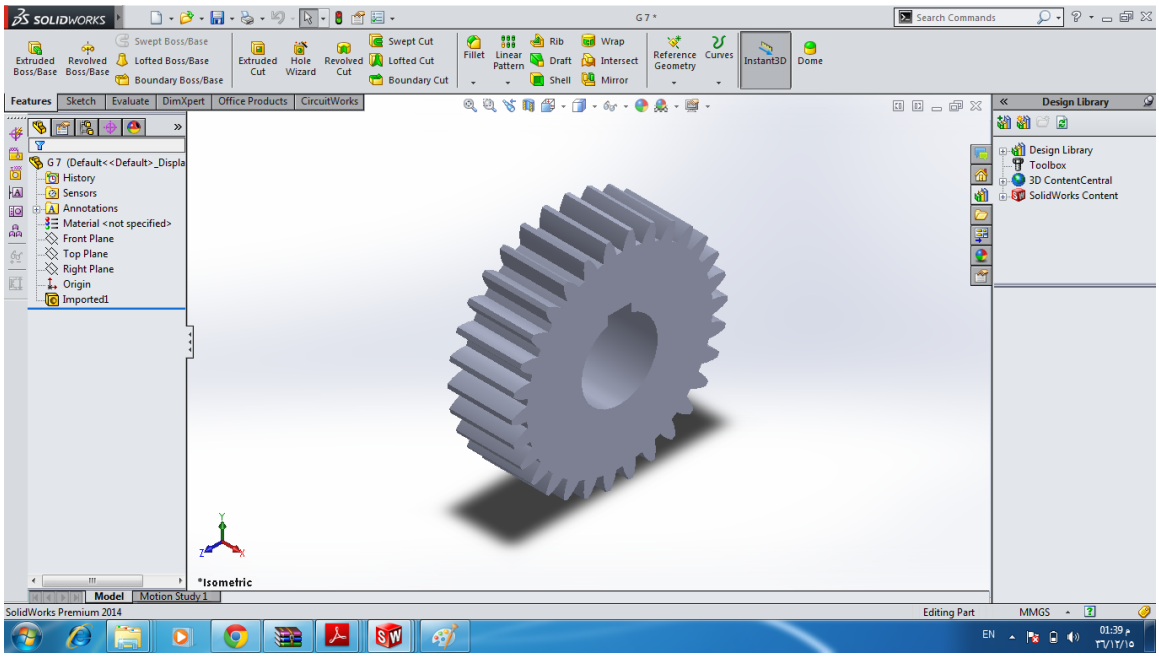
الشكل (6-4) يوضح الرسم ثلاثي الأبعاد للترس الرابع



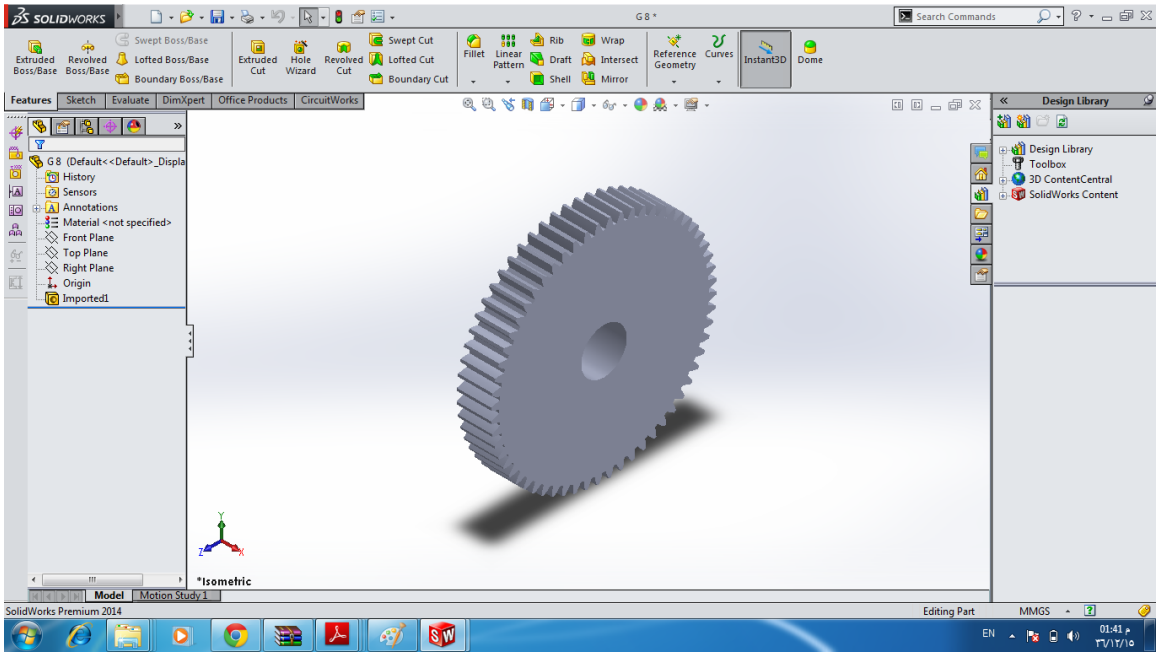
الشكل (6-5) يوضح الرسم ثلاثي الأبعاد للترس الخامس



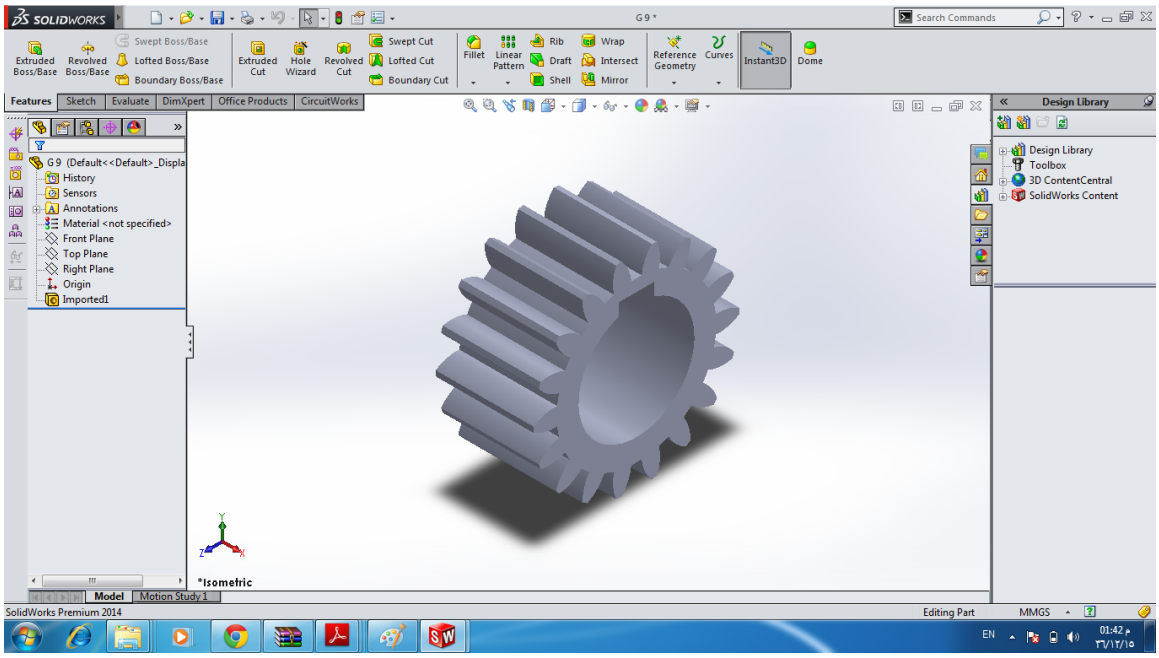
الشكل (6-6) يوضح الرسم ثلاثي الأبعاد للترس السادس



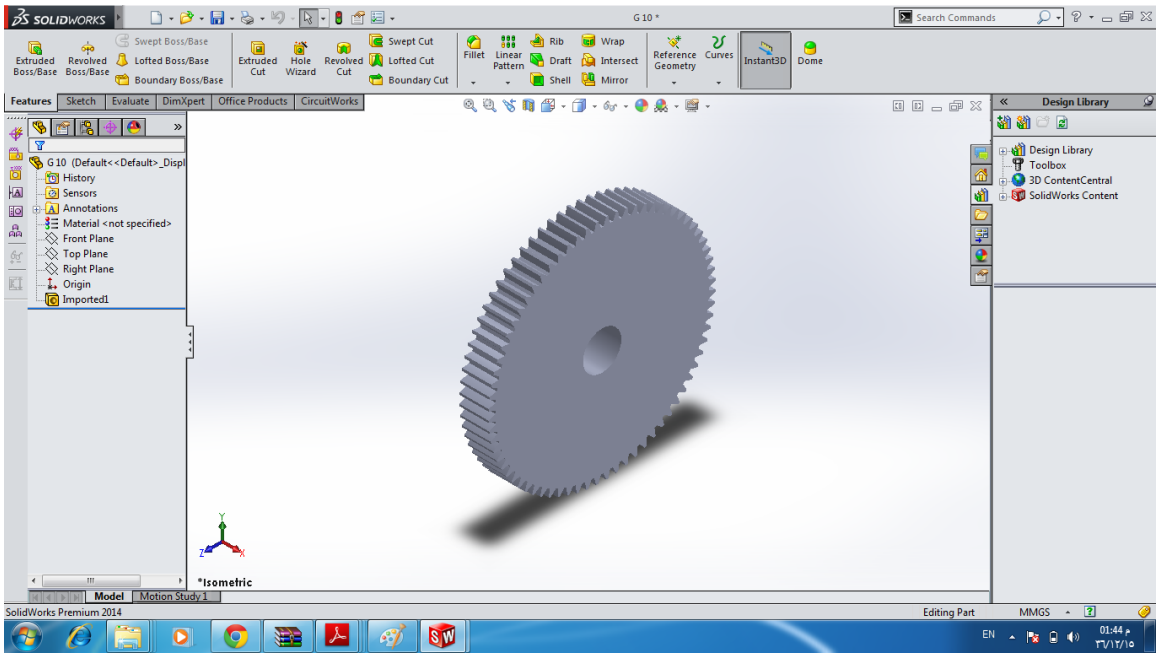
الشكل (6-7) يوضح الرسم ثلاثي الأبعاد للترس السابع



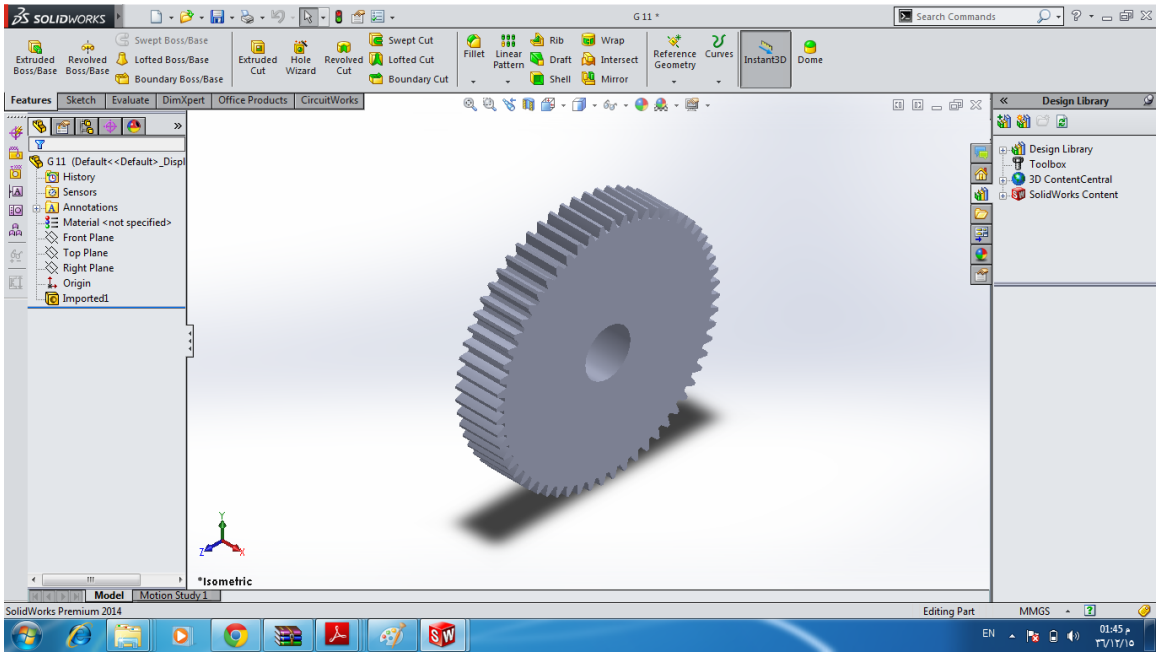
الشكل (6-8) يوضح الرسم ثلاثي الأبعاد للترس الثامن



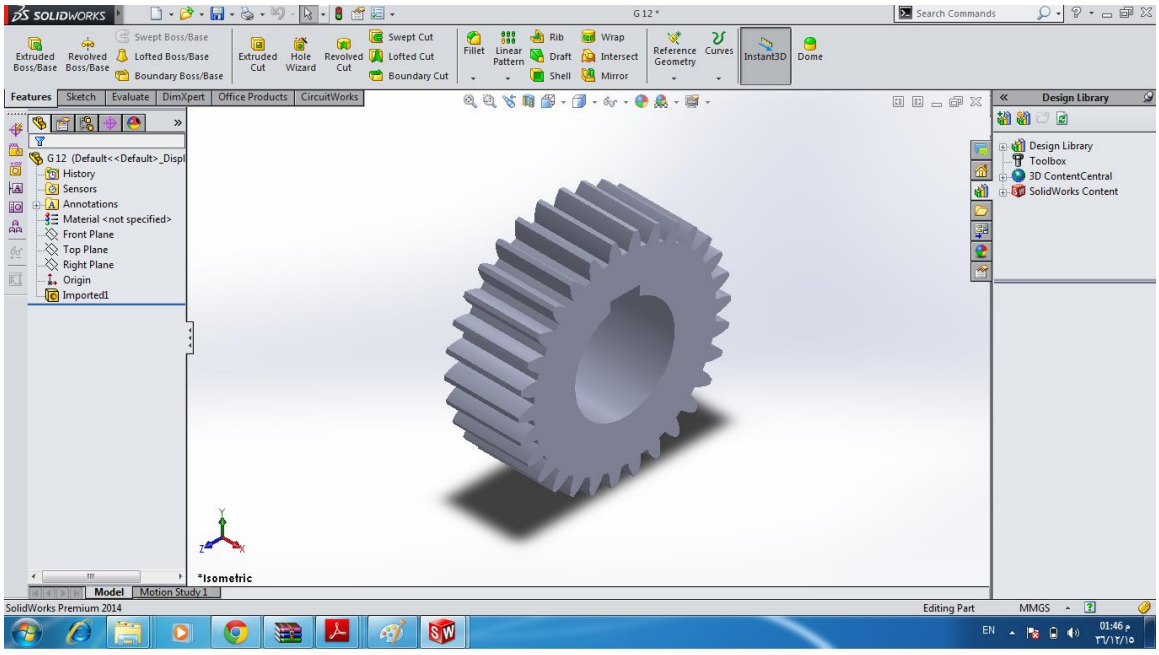
الشكل (6-9) يوضح الرسم ثلاثي الأبعاد للترس التاسع



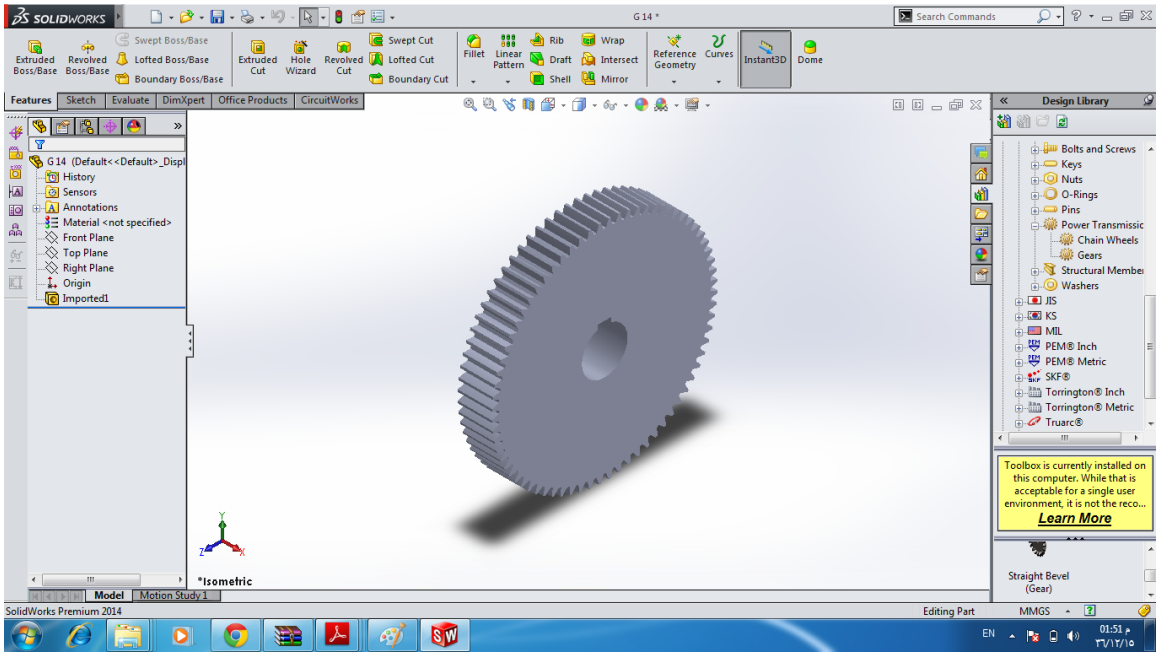
الشكل (6-10) يوضح الرسم ثلاثي الأبعاد للترس العاشر



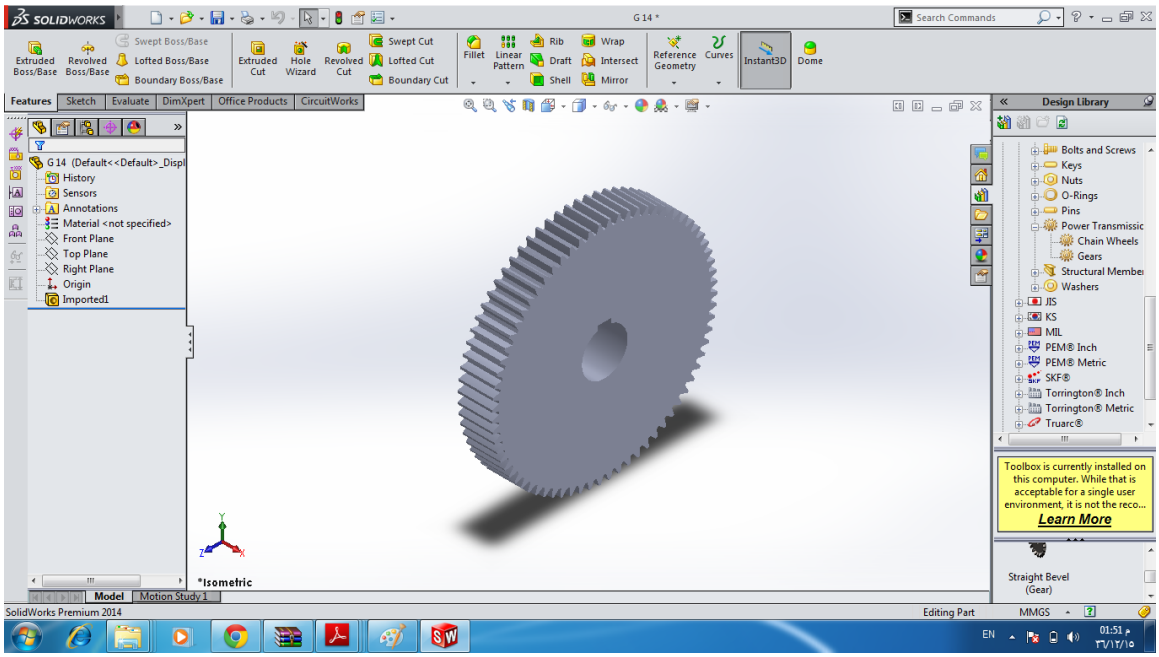
الشكل (6-11) يوضح الرسم ثلاثي الأبعاد للترس رقم 11



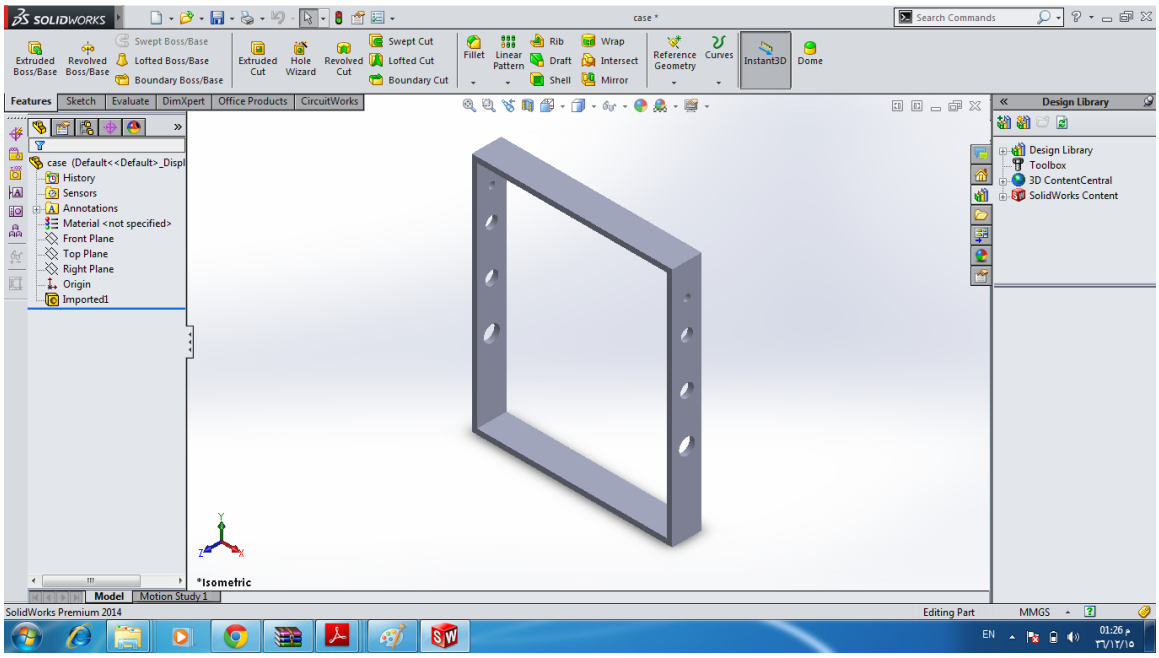
الشكل (6-12) يوضح الرسم ثلاثي الأبعاد للترس رقم 12



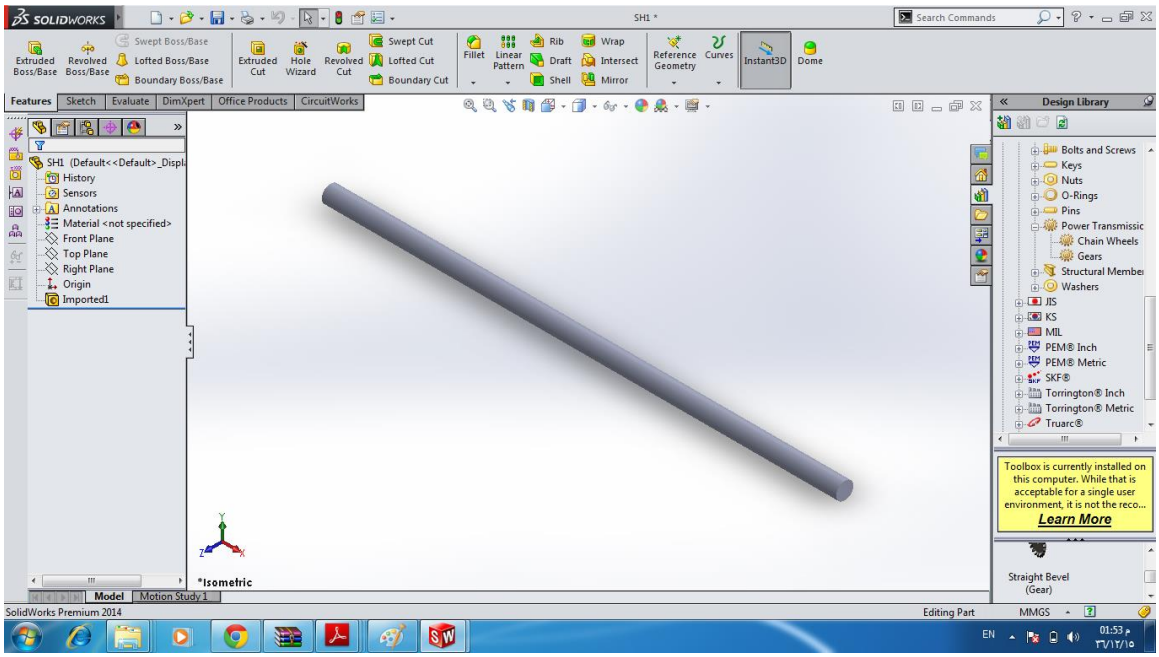
الشكل (6-13) يوضح الرسم ثلاثي الأبعاد للترس رقم 13



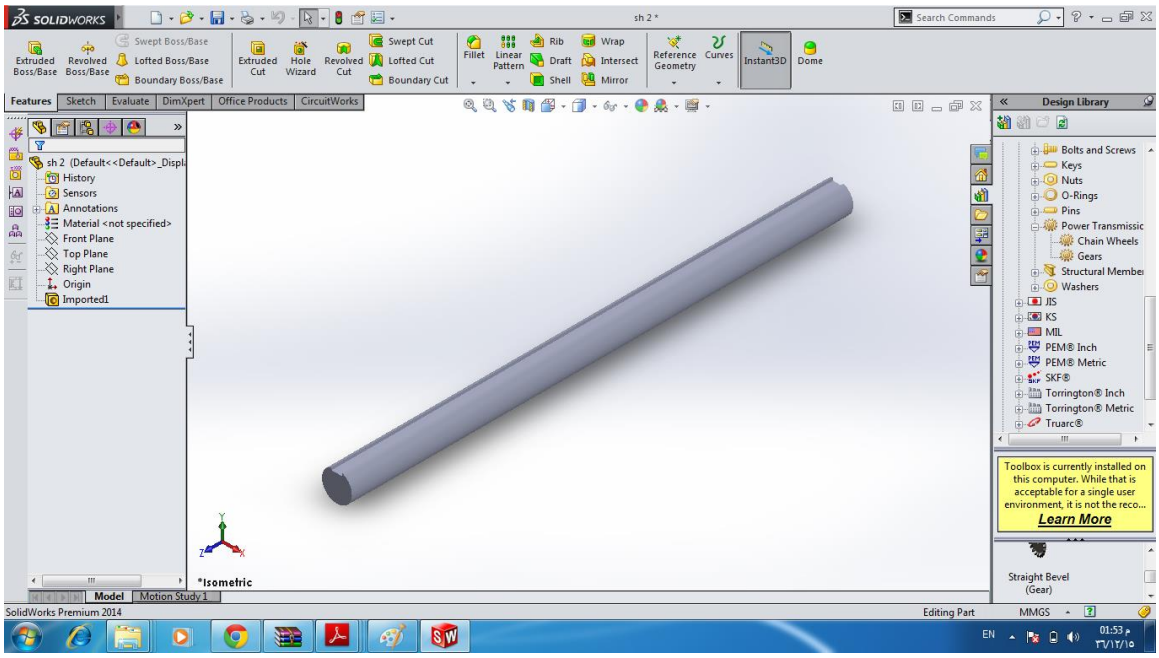
الشكل (6-14) يوضح الرسم ثلاثي الأبعاد للترس رقم 14



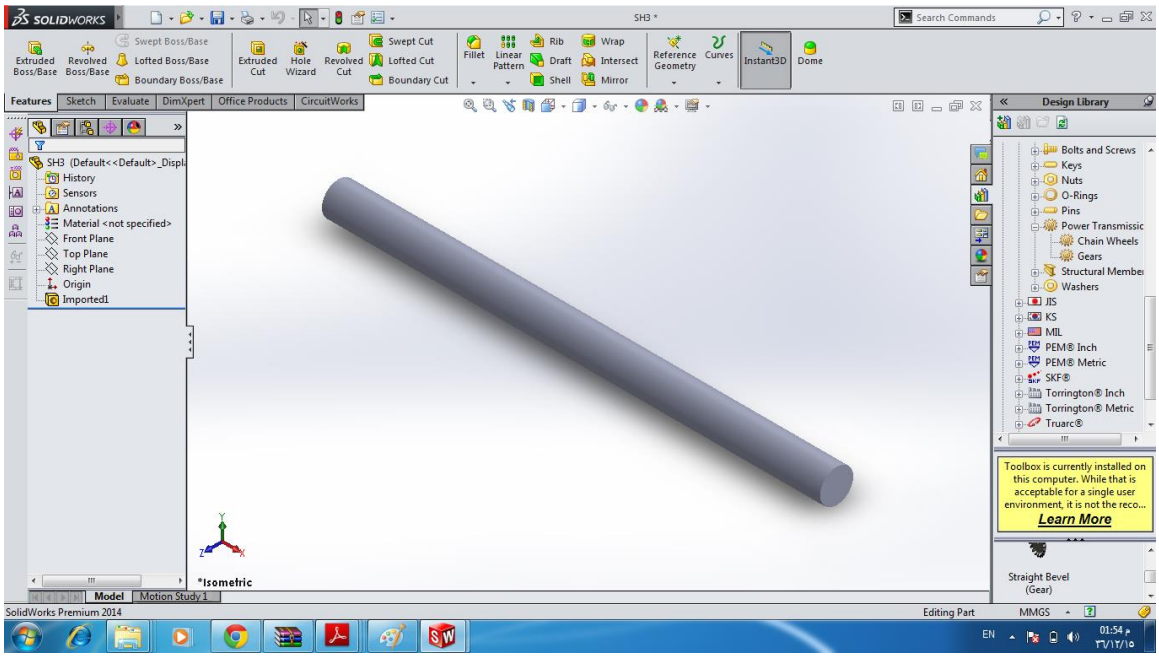
الشكل (6-15) يوضح الرسم ثلاثي الأبعاد لإطار علبة السرعات



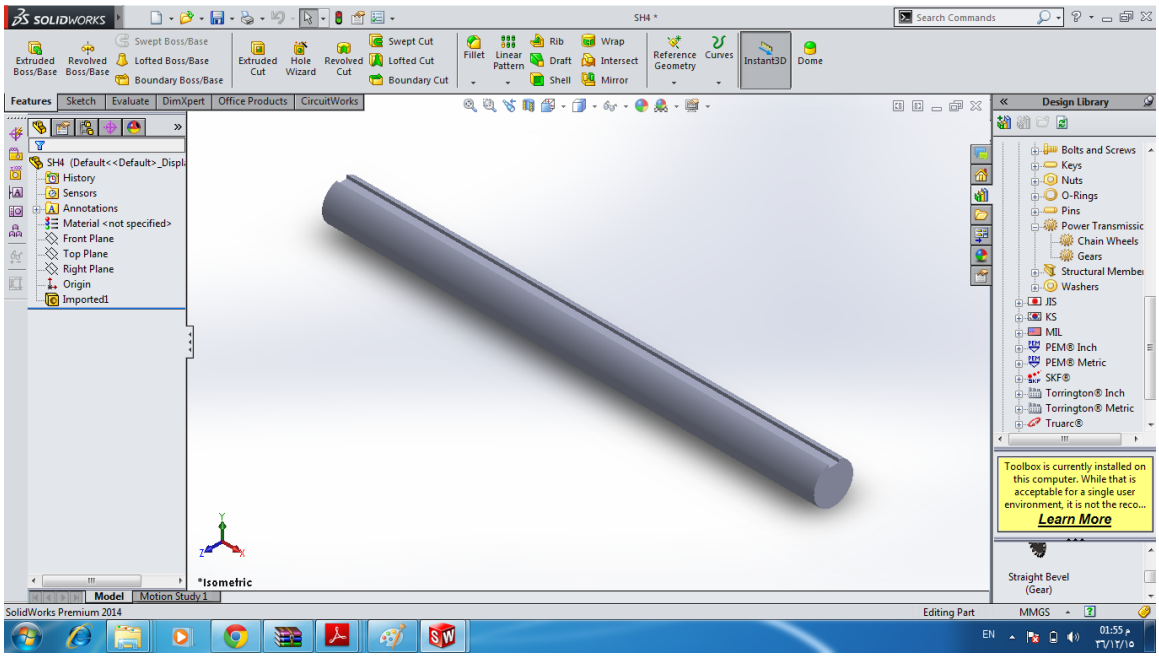
الشكل (6-16) يوضح الرسم ثلاثي الأبعاد للعمود الأول



الشكل (6-17) يوضح الرسم ثلاثي الأبعاد للعمود الثاني

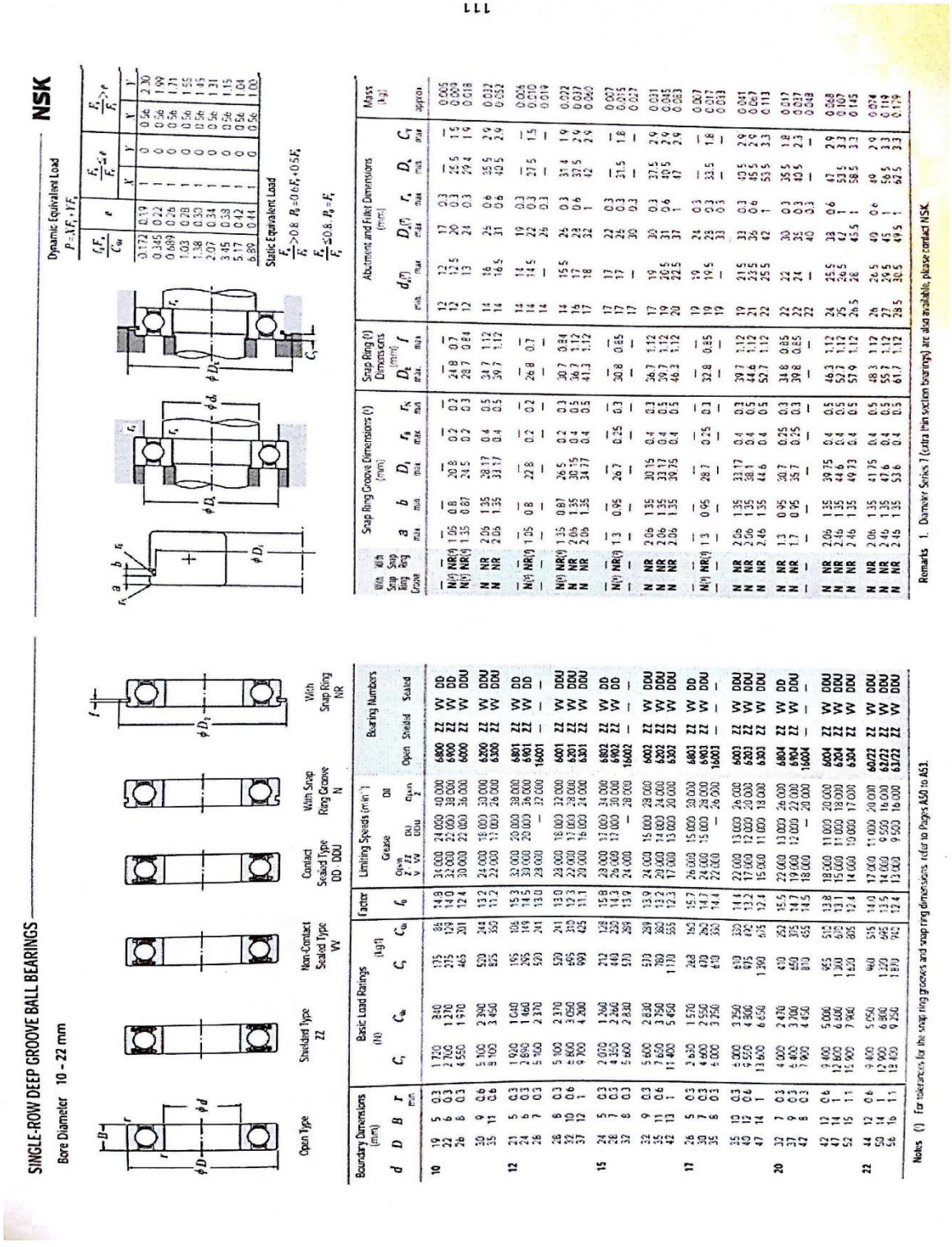


الشكل (6-18) يوضح الرسم ثلاثي الأبعاد للعمود الثالث



الشكل (6-19) يوضح الرسم ثلاثي الأبعاد للعمود الرابع

5-4-6 اختيار أبعاد المحامل:

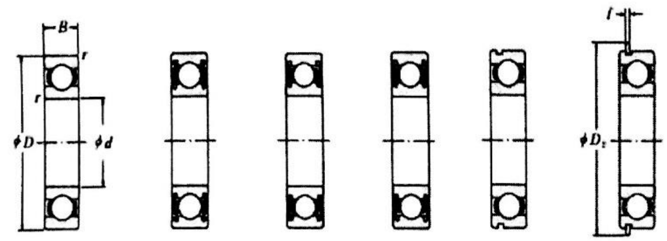


الجدول رقم (6-1) يوضح اختيار أبعاد المحامل

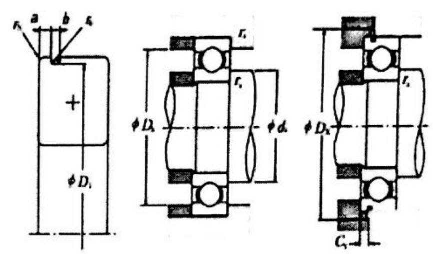
SINGLE-ROW DEEP GROOVE BALL BEARINGS

Bore Diameter 25 – 45 mm

NSK



Open Type | Shielded Type ZZ | Non-Contact Sealed Type VV | Contact Sealed Type DD · DDU | With Snap Ring Groove N | With Snap Ring NR



Dynamic Equivalent Load

$P = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22	1	0	0.56	1.99
0.689	0.26	1	0	0.56	1.71
1.03	0.28	1	0	0.56	1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38	1	0	0.56	1.15
5.17	0.42	1	0	0.56	1.04
6.89	0.44	1	0	0.56	1.00

Static Equivalent Load

$\frac{F_a}{F_r} > 0.8 \quad P_0 = 0.6F_r + 0.5F_a$

$\frac{F_a}{F_r} \le 0.8 \quad P_0 = F_r$

Boundary Dimensions (mm) d	D	B	r min	Basic Load Ratings (N) C_r	(N) C_{0r}	(kgf) C_r	(kgf) C_{0r}	Factor f_0	Limiting Speeds (min⁻¹) Grease Open Z ZZ V VV	Grease DU DDU	Oil Open Z	Bearing Numbers Open	Shielded	Sealed	
25	37	7	0.3	4 500	3 150	455	320	16.1	18 000	10 000	22 000	**6805**	ZZ	VV	DD
	42	9	0.3	7 050	4 550	715	460	15.4	16 000	10 000	19 000	**6905**	ZZ	VV	DDU
	47	8	0.3	8 850	5 600	905	570	15.1	15 000	—	18 000	**16005**	—	—	—
	47	12	0.6	10 100	5 850	1 030	595	14.5	15 000	9 500	18 000	**6005**	ZZ	VV	DDU
	52	15	1	14 000	7 850	1 430	800	13.9	13 000	9 000	15 000	**6205**	ZZ	VV	DDU
	62	17	1.1	20 600	11 200	2 100	1 150	13.2	11 000	8 000	13 000	**6305**	ZZ	VV	DDU
28	52	12	0.6	12 500	7 400	1 270	755	14.5	14 000	8 500	16 000	**60/28**	ZZ	VV	DDU
	58	16	1	16 600	9 500	1 700	970	13.9	12 000	8 000	14 000	**62/28**	ZZ	VV	DDU
	68	18	1.1	26 700	14 000	2 730	1 430	12.4	10 000	7 500	13 000	**63/28**	ZZ	VV	DDU
30	42	7	0.3	4 700	3 650	480	370	16.4	15 000	9 000	18 000	**6806**	ZZ	VV	DD
	47	9	0.3	7 250	5 000	740	510	15.8	14 000	8 500	17 000	**6906**	ZZ	VV	DDU
	55	9	0.3	11 200	7 350	1 150	750	15.2	13 000	—	15 000	**16006**	—	—	—
	55	13	1	13 200	8 300	1 350	845	14.7	13 000	8 000	15 000	**6006**	ZZ	VV	DDU
	62	16	1	19 500	11 300	1 980	1 150	13.8	11 000	7 500	13 000	**6206**	ZZ	VV	DDU
	72	19	1.1	26 700	15 000	2 720	1 530	13.3	9 500	6 700	12 000	**6306**	ZZ	VV	DDU
32	58	13	1	15 100	9 150	1 530	935	14.5	12 000	7 500	14 000	**60/32**	ZZ	VV	DDU
	65	17	1	20 700	11 600	2 120	1 190	13.6	10 000	7 100	12 000	**62/32**	ZZ	VV	DDU
	75	20	1.1	29 900	17 000	3 050	1 730	13.2	9 000	6 300	11 000	**63/32**	ZZ	VV	DDU
35	47	7	0.3	4 900	4 100	500	420	16.7	14 000	7 500	16 000	**6807**	ZZ	VV	DD
	55	10	0.6	10 600	7 250	1 080	740	15.5	12 000	7 500	15 000	**6907**	ZZ	VV	DDU
	62	9	0.3	11 700	8 200	1 190	835	15.6	11 000	—	13 000	**16007**	—	—	—
	62	14	1	16 000	10 300	1 630	1 050	14.8	11 000	6 700	13 000	**6007**	ZZ	VV	DDU
	72	17	1.1	25 700	15 300	2 620	1 560	13.8	9 500	6 300	11 000	**6207**	ZZ	VV	DDU
	80	21	1.5	33 500	19 200	3 400	1 960	13.2	8 500	6 000	10 000	**6307**	ZZ	VV	DDU
40	52	7	0.3	6 350	5 550	650	565	17.0	12 000	6 700	14 000	**6808**	ZZ	VV	DD
	62	12	0.6	13 700	10 000	1 390	1 020	15.7	11 000	6 300	13 000	**6908**	ZZ	VV	DDU
	68	9	0.3	12 600	9 650	1 290	985	16.0	10 000	—	12 000	**16008**	—	—	—
	68	15	1	16 800	11 500	1 710	1 180	15.3	10 000	6 000	12 000	**6008**	ZZ	VV	DDU
	80	18	1.1	29 100	17 900	2 970	1 820	14.0	8 500	5 600	10 000	**6208**	ZZ	VV	DDU
	90	23	1.5	40 500	24 000	4 150	2 450	13.2	7 500	5 300	9 000	**6308**	ZZ	VV	DDU
45	58	7	0.3	6 600	6 150	670	625	17.2	11 000	6 000	13 000	**6809**	ZZ	VV	DD
	68	12	0.6	14 100	10 900	1 440	1 110	15.9	9 500	5 600	12 000	**6909**	ZZ	VV	DDU
	75	10	0.6	14 900	11 400	1 520	1 160	15.9	9 000	—	11 000	**16009**	—	—	—
	75	16	1	20 900	15 200	2 140	1 550	15.3	9 000	5 300	11 000	**6009**	ZZ	VV	DDU
	85	19	1.1	31 500	20 400	3 200	2 080	14.4	7 500	5 300	9 000	**6209**	ZZ	VV	DDU
	100	25	1.5	53 000	32 000	5 400	3 250	13.1	6 700	4 800	8 000	**6309**	ZZ	VV	DDU

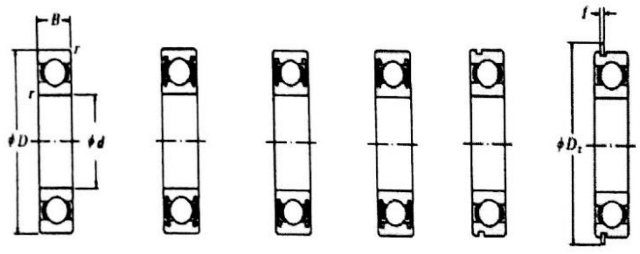
Bearing Numbers Open	With Snap Ring Groove	With Snap Ring	Snap Ring Groove Dimensions (1) (mm) a max	b min	D_1 max	r_0 max	r_N min	Snap Ring (1) Dimensions (mm) D_2 max	f max	Abutment and Fillet Dimensions (mm) d_a (2) min	d_a (2) max	D_a (2) max	r_a max	D_X min	C_Y max	Mass (kg) approx
6805	N	NR	1.3	0.95	35.7	0.25	0.3	39.8	0.85	27	27	35	0.3	40.5	1.8	0.021
6905	N(1)	NR(1)	1.7	0.95	40.7	0.25	0.3	44.8	0.85	27	28.5	40	0.3	45.5	2.3	0.042
16005	—	—	—	—	—	—	—	—	—	27	—	45	0.3	—	—	0.059
6005	N	NR	2.06	1.35	44.6	0.4	0.5	52.7	1.12	29	30	43	0.6	53.5	2.9	0.078
6205	N	NR	2.46	1.35	49.73	0.4	0.5	57.9	1.12	30	32	47	1	58.5	3.3	0.129
6305	N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	31.5	36	55.5	1	68.5	4.6	0.235
60/28	N	NR	2.06	1.35	49.73	0.4	0.5	57.9	1.12	32	34	48	0.6	58.5	2.9	0.096
62/28	N	NR	2.46	1.35	55.6	0.4	0.5	63.7	1.12	33	35.5	53	1	64.5	3.3	0.175
63/28	N	NR	3.28	1.9	64.82	0.6	0.5	74.6	1.7	34.5	38	61.5	1	76	4.6	0.287
6806	N	NR	1.3	0.95	40.7	0.25	0.3	44.8	0.85	32	32	40	0.3	45.5	1.8	0.024
6906	N	NR	1.7	0.95	45.7	0.25	0.3	49.8	0.85	32	34	45	0.3	50.5	2.3	0.052
16006	—	—	—	—	—	—	—	—	—	32	—	53	0.3	—	—	0.087
6006	N	NR	2.08	1.35	52.6	0.4	0.5	60.7	1.12	35	36.5	50	1	61.5	2.9	0.116
6206	N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	35	38.5	57	1	68.5	4.6	0.199
6306	N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	36.5	42.5	65.5	1	80	4.6	0.345
60/32	N	NR	2.06	1.35	55.6	0.4	0.5	63.7	1.12	37	38.5	53	1	64.5	2.9	0.122
62/32	N	NR	3.28	1.9	62.6	0.6	0.5	70.7	1.7	37	40	60	1	71.5	4.6	0.225
63/32	N	NR	3.28	1.9	71.83	0.6	0.5	81.6	1.7	38.5	44.5	68.5	1	83	4.6	0.389
6807	N	NR	1.3	0.95	45.7	0.25	0.3	49.8	0.85	37	37	45	0.3	50.5	1.8	0.027
6907	N	NR	1.7	0.95	53.7	0.25	0.5	57.8	0.85	39	39	51	0.6	58.5	2.3	0.075
16007	—	—	—	—	—	—	—	—	—	37	—	60	0.3	—	—	0.107
6007	N	NR	2.08	1.9	59.61	0.6	0.5	67.7	1.7	40	41.5	57	1	68.5	3.4	0.151
6207	N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	41.5	44.5	65.5	1	80	4.6	0.284
6307	N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	43	47	72	1.5	88	4.6	0.464
6808	N	NR	1.3	0.95	50.7	0.25	0.3	54.8	0.85	42	42	50	0.3	55.5	1.8	0.031
6908	N	NR	1.7	0.95	60.7	0.25	0.5	64.8	0.85	44	46	58	0.6	65.5	2.3	0.112
16008	—	—	—	—	—	—	—	—	—	42	—	66	0.3	—	—	0.13
6008	N	NR	2.49	1.9	64.82	0.6	0.5	74.6	1.7	45	47.5	63	1	76	3.8	0.19
6208	N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	46.5	50.5	73.5	1	88	4.6	0.366
6308	N	NR	3.28	2.7	86.79	0.6	0.5	96.5	2.46	48	53	82	1.5	98	5.4	0.636
6809	N	NR	1.3	0.95	56.7	0.25	0.3	60.8	0.85	47	47.5	56	0.3	61.5	1.8	[illegible]
6909	N	NR	1.7	0.95	66.7	0.25	0.3(1)	70.8	0.85	49	50	64	0.6	72	2.3	0.126
16009	—	—	—	—	—	—	—	—	—	49	—	71	0.6	—	—	0.167
6009	N	NR	2.49	1.9	71.63	0.6	0.5	81.6	1.7	50	53.5	70	1	83	3.8	0.241
6209	N	NR	3.28	1.9	81.61	0.6	0.5	91.6	1.7	51.5	55.5	78.5	1	93	4.6	0.42
6309	N	NR	3.28	2.7	96.8	0.6	0.5	106.5	2.46	53	61.5	92	1.5	108	5.4	[illegible]

الجدول رقم (2-6) يوضح اختيار أبعاد المحامل

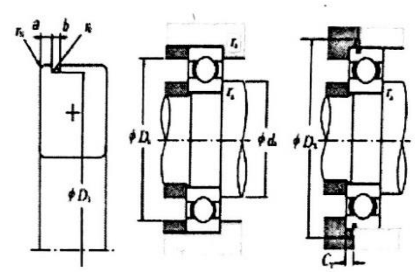
SINGLE-ROW DEEP GROOVE BALL BEARINGS

NSK

Bore Diameter 50 - 75 mm



Open Type — Shielded Type ZZ — Non-Contact Sealed Type VV — Contact Sealed Type DD · DDU — With Snap Ring Groove N — With Snap Ring NR



Dynamic Equivalent Load

$P = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22	1	0	0.56	1.99
0.689	0.26	1	0	0.56	1.71
1.03	0.28	1	0	0.56	1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38	1	0	0.56	1.15
5.17	0.42	1	0	0.56	1.04
6.89	0.44	1	0	0.56	1.00

Static Equivalent Load

$\frac{F_a}{F_r} > 0.8,\ P_0 = 0.6F_r + 0.5F_a$

$\frac{F_a}{F_r} \le 0.8,\ P_0 = F_r$

Boundary Dimensions (mm) d	D	B	r min.	Basic Load Ratings (N) C_r	(N) C_{0r}	{kgf} C_r	{kgf} C_{0r}	Factor f_0	Limiting Speeds (min⁻¹) Grease Open Z ZZ V VV	Grease DU DDU	Oil Open Z	Bearing Numbers Open	Shielded	Sealed	
50	65	7	0.3	6 400	6 200	655	635	17.2	9 500	5 300	11 000	**6810**	**ZZ**	**VV**	**DDU**
	72	12	0.6	14 500	11 700	1 480	1 200	16.1	9 000	5 300	11 000	**6910**	**ZZ**	**VV**	**DDU**
	80	10	0.6	15 400	12 400	1 570	1 260	16.1	8 500	—	10 000	**16010**	—	—	—
	80	16	1	21 800	16 600	2 220	1 700	15.6	8 500	4 800	10 000	**6010**	**ZZ**	**VV**	**DDU**
	90	20	1.1	35 000	23 200	3 600	2 370	14.4	7 100	4 800	8 500	**6210**	**ZZ**	**VV**	**DDU**
	110	27	2	62 000	38 500	6 300	3 900	13.2	6 000	4 300	7 500	**6310**	**ZZ**	**VV**	**DDU**
55	72	9	0.3	8 800	8 500	900	865	17.0	8 500	4 800	10 000	**6811**	**ZZ**	**VV**	**DDU**
	80	13	1	16 000	13 300	1 630	1 350	16.2	8 000	4 500	9 500	**6911**	**ZZ**	**VV**	**DDU**
	90	11	0.6	19 400	16 300	1 980	1 660	16.2	7 500	—	9 000	**16011**	—	—	—
	90	18	1.1	28 300	21 200	2 880	2 170	15.3	7 500	4 500	9 000	**6011**	**ZZ**	**VV**	**DDU**
	100	21	1.5	43 500	29 300	4 450	2 980	14.3	6 300	4 300	7 500	**6211**	**ZZ**	**VV**	**DDU**
	120	29	2	71 500	44 500	7 300	4 550	13.1	5 600	4 000	6 700	**6311**	**ZZ**	**VV**	**DDU**
60	78	10	0.3	11 500	10 900	1 170	1 120	16.9	8 000	4 500	9 500	**6812**	**ZZ**	**VV**	**DD**
	85	13	1	19 400	16 300	1 980	1 660	16.2	7 500	4 300	9 000	**6912**	**ZZ**	**VV**	**DDU**
	95	11	0.6	20 000	17 500	2 040	1 780	16.3	7 100	—	8 500	**16012**	—	—	—
	95	18	1.1	29 500	23 200	3 000	2 370	15.6	7 100	4 000	8 500	**6012**	**ZZ**	**VV**	**DDU**
	110	22	1.5	52 500	36 000	5 350	3 700	14.3	5 600	3 800	7 100	**6212**	**ZZ**	**VV**	**DDU**
	130	31	2.1	82 000	52 000	8 350	5 300	13.1	5 300	3 600	6 300	**6312**	**ZZ**	**VV**	**DDU**
65	85	10	0.6	11 900	12 100	1 220	1 230	17.0	7 500	4 000	8 500	**6813**	**ZZ**	**VV**	**DD**
	90	13	1	17 400	16 100	1 770	1 640	16.6	7 100	4 000	8 500	**6913**	**ZZ**	**VV**	**DDU**
	100	11	0.6	20 500	18 700	2 090	1 910	16.5	6 700	—	8 000	**16013**	—	—	—
	100	18	1.1	30 500	25 200	3 100	2 570	15.8	6 700	4 000	8 000	**6013**	**ZZ**	**VV**	**DDU**
	120	23	1.5	57 500	40 000	5 850	4 100	14.4	5 300	3 600	6 300	**6213**	**ZZ**	**VV**	**DDU**
	140	33	2.1	92 500	60 000	9 450	6 100	13.2	4 800	3 400	6 000	**6313**	**ZZ**	**VV**	**DDU**
70	90	10	0.6	12 100	12 700	1 230	1 300	17.2	6 700	3 800	8 000	**6814**	**ZZ**	**VV**	**DD**
	100	16	1	23 700	21 200	2 420	2 160	16.3	6 300	3 600	7 500	**6914**	**ZZ**	**VV**	**DDU**
	110	13	0.6	26 800	23 600	2 730	2 410	16.3	6 000	—	7 100	**16014**	—	—	—
	110	20	1.1	38 000	31 000	3 900	3 150	15.6	6 000	3 600	7 100	**6014**	**ZZ**	**VV**	**DDU**
	125	24	1.5	62 000	44 000	6 350	4 500	14.5	5 000	3 400	6 300	**6214**	**ZZ**	**VV**	**DDU**
	150	35	2.1	104 000	68 000	10 600	6 950	13.2	4 500	3 200	5 300	**6314**	**ZZ**	**VV**	**DDU**
75	95	10	0.6	12 500	13 900	1 280	1 410	17.3	6 300	3 600	7 500	**6815**	**ZZ**	**VV**	**DDU**
	105	16	1	24 400	22 600	2 480	2 300	16.5	6 000	3 400	7 100	**6915**	**ZZ**	**VV**	**DDU**
	115	13	0.6	27 600	25 300	2 820	2 580	16.4	5 600	—	6 700	**16015**	—	—	—
	115	20	1.1	39 500	33 500	4 050	3 400	15.8	5 600	3 400	6 700	**6015**	**ZZ**	**VV**	**DDU**
	130	25	1.5	66 000	49 500	6 750	5 050	14.7	4 800	3 200	5 600	**6215**	**ZZ**	**VV**	**DDU**
	160	37	2.1	113 000	77 000	11 600	7 850	13.2	4 300	2 800	5 000	**6315**	**ZZ**	**VV**	**DDU**

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A50 to A53.

With Snap Ring Groove	With Snap Ring	Snap Ring Groove Dimensions (1) (mm) a max.	b min.	D_1 max.	r_0 max.	r_N min.	Snap Ring (1) Dimensions (mm) D_2 max.	f max.	Abutment and Fillet Dimensions (mm) d_a min.	d_a max.	D_a max.	r_a max.	D_X min.	C_Y max.	Mass (kg) approx.
N	**NR**	1.3	0.95	63.7	0.25	0.3	67.8	0.85	52	52.5	63	0.3	68.5	1.8	0.050
N	**NR**	1.7	0.95	70.7	0.25	0.5	74.8	0.85	54	55	68	0.6	76	2.3	0.135
—	—	—	—	—	—	—	—	—	54	—	76	0.6	—	—	0.175
N	**NR**	2.49	1.9	76.81	0.6	0.5	86.6	1.7	55	58.5	75	1	88	3.8	0.261
N	**NR**	3.28	2.7	86.79	0.6	0.5	96.5	2.46	56.5	60	83.5	1	98	5.4	0.459
N	**NR**	3.28	2.7	106.81	0.6	0.5	116.6	2.46	59	68	101	2	118	5.4	1.06
N	**NR**	1.7	0.95	70.7	0.25	0.3	74.8	0.85	57	59	70	0.3	76	2.3	0.081
N	**NR**	2.1	1.3	77.9	0.4	0.5	84.4	1.12	60	61.5	75	1	86	2.9	0.189
—	—	—	—	—	—	—	—	—	59	—	86	0.6	—	—	0.257
N	**NR**	2.87	2.7	86.79	0.6	0.5	96.5	2.46	61.5	64	83.5	1	98	5	0.381
N	**NR**	3.28	2.7	96.8	0.6	0.5	106.5	2.46	63	66.5	92	1.5	108	5.4	0.619
N	**NR**	4.06	3.1	115.21	0.6	0.5	129.7	2.82	64	72.5	111	2	131.5	6.5	1.37
N	**NR**	1.7	1.3	76.2	0.4	0.3	82.7	1.12	62	64	76	0.3	84	2.5	0.103
N	**NR**	2.1	1.3	82.9	0.4	0.5	89.4	1.12	65	66	80	1	91	2.9	0.192
—	—	—	—	—	—	—	—	—	64	—	91	0.6	—	—	0.281
N	**NR**	2.87	2.7	91.82	0.6	0.5	101.6	2.46	66.5	69	88.5	1	103	5	0.412
N	**NR**	3.28	2.7	106.81	0.6	0.5	116.6	2.46	68	74.5	102	1.5	118	5.4	0.733
N	**NR**	4.06	3.1	125.22	0.6	0.5	139.7	2.82	71	79	119	2	141.5	6.5	1.72
N	**NR**	1.7	1.3	82.9	0.4	0.5	89.4	1.12	69	69	81	0.6	91	2.5	0.128
N	**NR**	2.1	1.3	87.9	0.4	0.5	94.4	1.12	70	71.5	85	1	96	2.9	0.218
—	—	—	—	—	—	—	—	—	69	—	96	0.6	—	—	0.30
N	**NR**	2.87	2.7	96.8	0.6	0.5	106.5	2.46	71.5	73	93.5	1	108	5	0.439
N	**NR**	4.06	3.1	115.21	0.6	0.5	129.7	2.82	73	80	112	1.5	131.5	6.5	1.0
N	**NR**	4.9	3.1	135.23	0.6	0.5	149.7	2.82	76	85.5	129	2	152	7.3	2.11
N	**NR**	1.7	1.3	87.9	0.4	0.5	94.4	1.12	74	74.5	86	0.6	96	2.5	0.134
N	**NR**	2.5	1.3	97.9	0.4	0.5	104.4	1.12	75	77.5	95	1	106	3.3	0.349
—	—	—	—	—	—	—	—	—	74	—	106	0.6	—	—	0.441
N	**NR**	2.87	2.7	106.81	0.6	0.5	116.6	2.46	76.5	80.5	103.5	1	118	5	0.608
N	**NR**	4.06	3.1	120.22	0.6	0.5	134.7	2.82	78	84	117	1.5	136.5	6.5	1.09
N	**NR**	4.9	3.1	145.24	0.6	0.5	159.7	2.82	81	92	139	2	162	7.3	2.57
N	**NR**	1.7	1.3	92.9	0.4	0.5	99.4	1.12	79	79.5	91	0.6	101	2.5	0.149
N	**NR**	2.5	1.3	102.6	0.4	0.5	110.7	1.12	80	82	100	1	112	3.3	0.364
—	—	—	—	—	—	—	—	—	79	—	111	0.6	—	—	0.463
N	**NR**	2.87	2.7	111.81	0.6	0.5	121.6	2.46	81.5	85.5	108.5	1	123	5	0.643
N	**NR**	4.06	3.1	125.22	0.6	0.5	139.7	2.82	83	90	122	1.5	141.5	6.5	1.14
N	**NR**	4.9	3.1	155.22	0.6	0.5	169.7	2.82	86	98.5	149	2	172	7.3	3.03

Remarks 1 Diameter Series 7 (extra thin section bearings) are also available, please contact NSK

الجدول رقم (3-6) يوضح اختيار أبعاد المحامل

6-4-6 اختيار أبعاد الخابور:

Shaft diameter (mm) upto and including	Key cross-section		Shaft diameter (mm) upto and including	Key cross-section	
	Width (mm)	Thickness (mm)		Width (mm)	Thickness (mm)
6	2	2	85	25	14
8	3	3	95	28	16
10	4	4	110	32	18
12	5	5	130	36	20
17	6	6	150	40	22
22	8	7	170	45	25
30	10	8	200	50	28
38	12	8	230	56	32
44	14	9	260	63	32
50	16	10	290	70	36
58	18	11	330	80	40
65	20	12	380	90	45
75	22	14	440	100	50

الجدول رقم (6-4) يوضح اختيار أبعاد الخابور