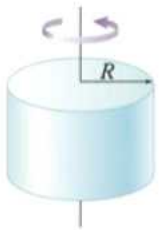
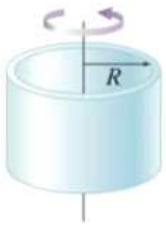
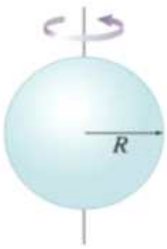
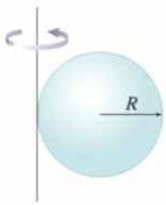
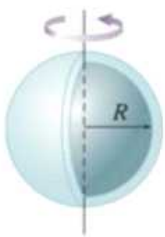
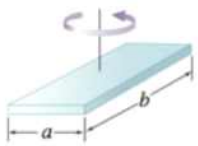
## 1. 관성 모멘트 개념

관성 모멘트는, 회전하는 물체의 중심축에서 회전운동을 시키기 위한 「회전체의 질량 M[kg]과 회전체의 회전반경 R[m]의 제곱의 곱 = M × $R^2$」의 회전 관성모멘트[J = $kg.m^2$]의 형태로 계산되는 회전력에 대해 저항하기 위한 관성 수치이다.

## 2. 관성 모멘트 필요성

회전 운동을 하는 물체에 대해 회전을 시키기 위하여 또는 멈추게 하기 위한 토크를 알 필요성이 있다.
관성 모멘트가 크면 회전하는 물체를 움직이거나 멈추기 위해 큰 회전력(토크)가 필요하다.
관성 모멘트가 작으면 적은 회전력(토크)로 물체를 쉽게 움직일 수 있다.
관성 모멘트는 토크를 받는 회전하는 물체가 갖는 회전력에 대한 저항의 크기라고 생각하면 된다.

## 3. 관성모멘트 계산식

| 물체의 형태 | | 관성모멘트 | 물체의 형태 | | 관성모멘트 |
|---|---|---|---|---|---|
| 속이 꽉 찬<br>원통 또는 원판 |  | $I = \frac{1}{2}MR^2$<br>$I = \frac{15}{30}MR^2$ | 두께가 얇고<br>속이 빈<br>원통이나 고리 |  | $I = MR^2$<br>$I = \frac{30}{30}MR^2$ |
| 속이 꽉 찬 구<br>(회전축이 구의<br>중심을 지남) |  | $I = \frac{2}{5}MR^2$<br>$I = \frac{12}{30}MR^2$ | 속이 꽉 찬 구<br>(회전축이<br>표면의 접선을<br>지남) |  | $I = \frac{7}{5}MR^2$<br>$I = \frac{42}{30}MR^2$ |
| 두께가 얇고,<br>속이 빈 구<br>껍질 |  | $I = \frac{2}{3}MR^2$<br>$I = \frac{20}{30}MR^2$ | 얇은<br>직사각형판<br>(회전축이 넓은<br>판 중심을<br>지남) |  | $I = \frac{1}{12}M \times (a^2 + b^2)$ |

## 4. (조건표) 환봉 형상의 관성 모멘트 조건표 및 이용방법

(예시) 직경 205mm, 두께 20mm, 재질 알루미늄의 경우,
(표에서 세로축 200과 가로축 5의 교차란의 수치) × (20mm는 10mm의 2배이므로 2를 곱하고)
(재질에 의한 철과의 비율 0.33(알루미늄 예시)을 곱한 철에 대한 상대 비중 수치)
= (0.013610842) × {2} × (0.33)

튜브 형태인 경우 (외경에서 구한 값) - (내경에서 구한 값)

환봉 : 길이 10 mm, 철의 비중 = 7.85

(단위 : $kg.m^2$)

| 지름 [mm] | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.000000077 | 0.000000113 | 0.000000160 | 0.000000220 | 0.000000296 | 0.000000390 | 0.000000505 | 0.000000644 | 0.000000809 | 0.000001004 |
| 20 | 0.000001233 | 0.000001499 | 0.000001805 | 0.000002157 | 0.000002557 | 0.000003010 | 0.000003522 | 0.000004096 | 0.000004737 | 0.000005451 |
| 30 | 0.000006242 | 0.000007117 | 0.000008081 | 0.000009140 | 0.000010299 | 0.000011565 | 0.000012944 | 0.000014444 | 0.000016070 | 0.000017829 |
| 40 | 0.000019729 | 0.000021777 | 0.000023981 | 0.000026348 | 0.000028886 | 0.000031602 | 0.000034506 | 0.000037606 | 0.000040910 | 0.000044428 |
| 50 | 0.000048167 | 0.000052138 | 0.000056349 | 0.000060810 | 0.000065531 | 0.000070521 | 0.000075792 | 0.000081352 | 0.000087213 | 0.000093385 |
| 60 | 0.000099879 | 0.000106706 | 0.000113877 | 0.000121404 | 0.000129297 | 0.000137570 | 0.000146233 | 0.000155299 | 0.000164780 | 0.000174689 |
| 70 | 0.000185038 | 0.000195841 | 0.000207109 | 0.000218857 | 0.000231098 | 0.000243845 | 0.000257113 | 0.000270915 | 0.000285265 | 0.000300177 |
| 80 | 0.000315667 | 0.000331749 | 0.000348438 | 0.000365748 | 0.000383695 | 0.000402296 | 0.000421564 | 0.000441516 | 0.000462168 | 0.000483537 |
| 90 | 0.000505638 | 0.000528488 | 0.000552104 | 0.000576503 | 0.000601701 | 0.000627717 | 0.000654568 | 0.000682270 | 0.000710843 | 0.000740304 |
| 100 | 0.000770672 | 0.000801964 | 0.000834200 | 0.000867398 | 0.000901577 | 0.000936757 | 0.000972956 | 0.001010194 | 0.001048491 | 0.001087866 |
| 110 | 0.001128341 | 0.001169934 | 0.001212667 | 0.001256560 | 0.001301634 | 0.001347910 | 0.001395409 | 0.001444152 | 0.001494162 | 0.001545459 |
| 120 | 0.001598065 | 0.001652004 | 0.001707296 | 0.001763965 | 0.001822033 | 0.001881523 | 0.001942458 | 0.002004862 | 0.002068757 | 0.002134167 |
| 130 | 0.002201116 | 0.002269628 | 0.002339727 | 0.002411438 | 0.002484785 | 0.002559792 | 0.002636484 | 0.002714887 | 0.002795026 | 0.002876926 |
| 140 | 0.002960613 | 0.003046113 | 0.003133451 | 0.003222654 | 0.003313748 | 0.003406760 | 0.003501716 | 0.003598644 | 0.003697570 | 0.003798522 |
| 150 | 0.003901527 | 0.004006612 | 0.004113807 | 0.004223138 | 0.004334634 | 0.004448323 | 0.004564234 | 0.004682396 | 0.004802838 | 0.004925588 |
| 160 | 0.005050676 | 0.005178131 | 0.005307984 | 0.005440264 | 0.005575001 | 0.005712225 | 0.005851967 | 0.005994258 | 0.006139128 | 0.006286608 |
| 170 | 0.006436729 | 0.006589523 | 0.006745022 | 0.006903256 | 0.007064258 | 0.007228060 | 0.007394694 | 0.007564193 | 0.007736590 | 0.007911916 |
| 180 | 0.008090206 | 0.008271492 | 0.008455808 | 0.008643187 | 0.008833663 | 0.009027271 | 0.009224043 | 0.009424015 | 0.009627221 | 0.009833696 |
| 190 | 0.010043474 | 0.010256591 | 0.010473081 | 0.010692981 | 0.010916325 | 0.011143151 | 0.011373492 | 0.011607387 | 0.011844870 | 0.012085980 |
| 200 | 0.012330751 | 0.012579222 | 0.012831429 | 0.013087410 | 0.013347202 | 0.013610842 | 0.013878369 | 0.014149821 | 0.014425235 | 0.014704650 |
| 210 | 0.014988105 | 0.015275639 | 0.015567289 | 0.015863096 | 0.016163099 | 0.016467338 | 0.016775851 | 0.017088679 | 0.017405862 | 0.017727439 |

(단위 : $kg.m^2$)

| 지름 [mm] | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 220 | 0.018053453 | 0.018383942 | 0.018718948 | 0.019058513 | 0.019402676 | 0.019751479 | 0.020104964 | 0.020463173 | 0.020826147 | 0.021193929 |
| 230 | 0.021566561 | 0.021944085 | 0.022326543 | 0.022713980 | 0.023106437 | 0.023503958 | 0.023906586 | 0.024314365 | 0.024727339 | 0.025145551 |
| 240 | 0.025569046 | 0.025997867 | 0.026432060 | 0.026871669 | 0.027316739 | 0.027767315 | 0.028223442 | 0.028685166 | 0.029152532 | 0.029625585 |
| 250 | 0.030104373 | 0.030588941 | 0.031079335 | 0.031575602 | 0.032077788 | 0.032585941 | 0.033100108 | 0.033620336 | 0.034146671 | 0.034679163 |
| 260 | 0.035217858 | 0.035762805 | 0.036314052 | 0.036871648 | 0.037435640 | 0.038006077 | 0.038583009 | 0.039166485 | 0.039756553 | 0.040353264 |
| 270 | 0.040956667 | 0.041566812 | 0.042183748 | 0.042807527 | 0.043438198 | 0.044075812 | 0.044720421 | 0.045372074 | 0.046030822 | 0.046696719 |
| 280 | 0.047369814 | 0.048050159 | 0.048737807 | 0.049432809 | 0.050135218 | 0.050845087 | 0.051562466 | 0.052287411 | 0.053019973 | 0.053760206 |
| 290 | 0.054508163 | 0.055263897 | 0.056027463 | 0.056798914 | 0.057578305 | 0.058365689 | 0.059161121 | 0.059964656 | 0.060776349 | 0.061596254 |
| 300 | 0.062424428 | 0.063260924 | 0.064105800 | 0.064959110 | 0.065820910 | 0.066691258 | 0.067570208 | 0.068457818 | 0.069354144 | 0.070259243 |
| 310 | 0.071173173 | 0.072095990 | 0.073027751 | 0.073968515 | 0.074918340 | 0.075877282 | 0.076845401 | 0.077822755 | 0.078809402 | 0.079805401 |
| 320 | 0.080810811 | 0.081825691 | 0.082850100 | 0.083884098 | 0.084927745 | 0.085981100 | 0.087044223 | 0.088117174 | 0.089200015 | 0.090292805 |
| 330 | 0.091395605 | 0.092508476 | 0.093631480 | 0.094764677 | 0.095908129 | 0.097061898 | 0.098226046 | 0.099400634 | 0.100585725 | 0.101781382 |
| 340 | 0.102987667 | 0.104204642 | 0.105432372 | 0.106670918 | 0.107920344 | 0.109180714 | 0.110452092 | 0.111734541 | 0.113028126 | 0.114332910 |
| 350 | 0.115648959 | 0.116976337 | 0.118315108 | 0.119665338 | 0.121027092 | 0.122400436 | 0.123785434 | 0.125182153 | 0.126590658 | 0.128011016 |
| 360 | 0.129443293 | 0.130887556 | 0.132343871 | 0.133812305 | 0.135292925 | 0.136785798 | 0.138290992 | 0.139808575 | 0.141338613 | 0.142881176 |
| 370 | 0.144436331 | 0.146004146 | 0.147584691 | 0.149178034 | 0.150784243 | 0.152403388 | 0.154035538 | 0.155680763 | 0.157339132 | 0.159010715 |
| 380 | 0.160695582 | 0.162393804 | 0.164105449 | 0.165830590 | 0.167569297 | 0.169321641 | 0.171087693 | 0.172867524 | 0.174661206 | 0.176468810 |
| 390 | 0.178290408 | 0.180126073 | 0.181975876 | 0.183839890 | 0.185718188 | 0.187610842 | 0.189517926 | 0.191439512 | 0.193375674 | 0.195326485 |
| 400 | 0.197292019 | 0.199272350 | 0.201267552 | 0.203277699 | 0.205302866 | 0.207343127 | 0.209398557 | 0.211469232 | 0.213555226 | 0.215656615 |
| 410 | 0.217773473 | 0.219905878 | 0.222053905 | 0.224217630 | 0.226397129 | 0.228592479 | 0.230803757 | 0.233031039 | 0.235274402 | 0.237533924 |
| 420 | 0.239809682 | 0.242101753 | 0.244410216 | 0.246735148 | 0.249076628 | 0.251434733 | 0.253809543 | 0.256201136 | 0.258609591 | 0.261034987 |
| 430 | 0.263477403 | 0.265936918 | 0.268413613 | 0.270907567 | 0.273418861 | 0.275947573 | 0.278493785 | 0.281057578 | 0.283639031 | 0.286238226 |
| 440 | 0.288855244 | 0.291490167 | 0.294143075 | 0.296814051 | 0.299503176 | 0.302210532 | 0.304936201 | 0.307680267 | 0.310442811 | 0.313223916 |
| 450 | 0.316023666 | 0.318842142 | 0.321679430 | 0.324535612 | 0.327410771 | 0.330304992 | 0.333218359 | 0.336150957 | 0.339102868 | 0.342074179 |
| 460 | 0.345064974 | 0.348075337 | 0.351105355 | 0.354155112 | 0.357224694 | 0.360314187 | 0.363423677 | 0.366553249 | 0.369702990 | 0.372872987 |
| 470 | 0.376063326 | 0.379274094 | 0.382505378 | 0.385757265 | 0.389029843 | 0.392323199 | 0.395637421 | 0.398972597 | 0.402328815 | 0.405706163 |
| 480 | 0.409104730 | 0.412524605 | 0.415965876 | 0.419428632 | 0.422912963 | 0.426418959 | 0.429946708 | 0.433496301 | 0.437067827 | 0.440661377 |
| 490 | 0.444277042 | 0.447914910 | 0.451575074 | 0.455257625 | 0.458962652 | 0.462690249 | 0.466440505 | 0.470213513 | 0.474009365 | 0.477828152 |
| 500 | 0.481669967 | 0.485534903 | 0.489423051 | 0.493334504 | 0.497269356 | 0.501227700 | 0.505209628 | 0.509215235 | 0.513244614 | 0.517297858 |