

WHEELCHAIR SKILLS PROGRAM (WSP) 4.1 OBSTACLE COURSE GUIDELINES

WSP 4.1 assessment and training activities can take place in any environment, because the obstacles are based on common ones found in hospitals, rehabilitation centers and the community.

However, this document is intended to assist those in the process of setting up an obstacle course to permit WSP 4.1 activities. It is only a guideline.

Table 1: Obstacle course requirements for the specific skills in WSP version 4.1

Wheelchair Skill	Equipment/ Measurements	Materials Required	Refer to Instruction Section pp 15-20
1. Moves controller away and back	None	None	None
2. Turns controller on and off	None	None	None
3. Selects drive modes and speeds	None	None	None
4. Controls tilt function	None	None	None
5. Controls recline function	None	None	None
6. Disengages and engages motors	None	None	None
7. Operates battery charger	None	None	None
8. Rolls forward 10m	<ul style="list-style-type: none"> • A smooth level surface, 1.2m wide and 10m long. • Starting, halfway and finishing lines at 0, 5 and 10m. • Space at least 1.5m before the starting line and beyond the finishing line. 	Wheelchair, tape measure, tape	A
9. Rolls forward 10m in 30s	<ul style="list-style-type: none"> • As for “rolls forward 10m” skill 	As above	As above
10. Rolls backward 5m	<ul style="list-style-type: none"> • A smooth level surface, 1.2m wide and 5m long. • Starting and finishing lines at 0 and 5m. • Space at least 1.5m before the starting line and beyond the 	Wheelchair, tape measure, tape	A

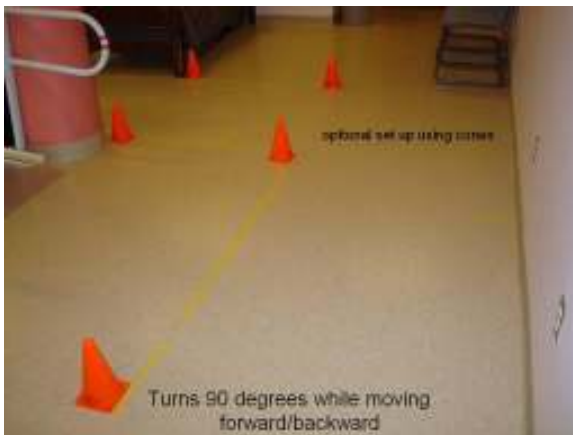
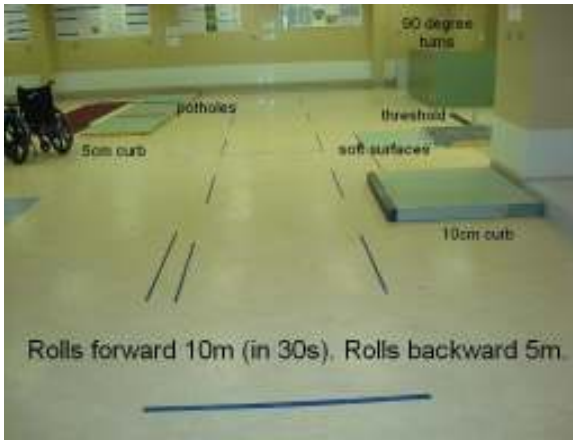
	finishing line.		
11. Turns 90° while moving forward ^{L&R}	<ul style="list-style-type: none"> • 1.2m wide level surface with a 90° turn. Solid barriers (preferred) or lines may be used to define the lateral limits. • Start and finish lines perpendicular to the line of progression, each 0.5m from the corner. • At least 1.5m space before the starting line and beyond the finishing line. 	Wheelchair, tape measure, tape, string, chalk	A and C
12. Turns 90° while moving backward ^{L&R}	<ul style="list-style-type: none"> • As for previous skill. 	As above	As above
13. Turns 180° in place ^{L&R}	<ul style="list-style-type: none"> • Smooth level surface and a 1.5m square, marked out by lines on the floor. 	Tape measure, tape, chalk, string	A and C
14. Maneuvers sideways ^{L&R}	<ul style="list-style-type: none"> • Target lateral barrier or line on at least one side. • Start line on floor 0.5m from the target and parallel to it. • Finish line on floor 10 cm from the target and parallel to it. • Two lines perpendicular to the lateral target to limit the extent of forward-backward movement to 1.5m. 	Tape measure, tape	A
15. Gets through hinged door in both directions	<ul style="list-style-type: none"> • Door ~81cm wide, preferably with little or no resistance to opening. • Preferably a lever knob >10 cm in length and 75-90cm above the floor. • Preferably no threshold. • There should be enough space (preferably at least 1.5m²), on both sides of the door, to allow the subject to maneuver. 	Tape measure, ruler	A
16. Reaches 1.5m high object	<ul style="list-style-type: none"> • Target no larger than 2.5 cm in diameter, attached to a wall or post, 1.5m above the floor. 	Tape measure, ruler	A
17. Picks object from floor	<ul style="list-style-type: none"> • Piece of wood (pine, 5x10x10cm, weight ~0.2kg). Any object of roughly equivalent size and weight (e.g. a book or a stick) may be used. 	Ruler	A
18. Relieves weight	None	None	None

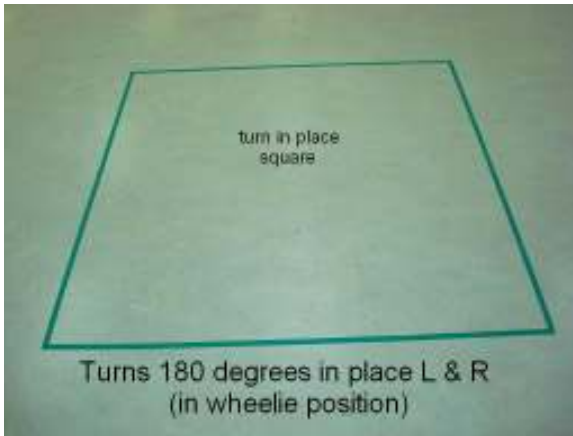
from buttocks			
19 Transfers from WC to bench and back.	<ul style="list-style-type: none"> The following transfer surface is suggested (although any equivalent one is acceptable): a bench with a padded flat surface, no backrest and no armrests. The sitting surface should be at least 1.0m wide, at least 0.5m deep and 45-47 cm high. The bench legs should have non-slip material (e.g. rubber) on their undersurfaces. A transfer board (a rectangular piece of wood or plastic with bevelled edges) should be made available for subjects who ordinarily use one. The subject may use his/her own equipment (if carried). The transfer board should be on the transfer bench within the subject's reach. 	Tape measure	A
20. Folds and unfolds wheelchair	<ul style="list-style-type: none"> Transfer bench. 	As above	As above
21. Rolls 100m	<ul style="list-style-type: none"> A smooth level surface at least 1.5m wide and 100m long. Using multiple laps of a shorter distance is permissible, but it is preferable for the straight stretches to be at least 25m, to minimize the number of turns. A curved path may be used. Space at least 1.5m before the starting line and beyond the finishing line. 	Wheelchair, tape measure, tape	A
22. Avoids moving obstacles ^{L&R}	<ul style="list-style-type: none"> Corridor or pathway as for the "rolling 100m" skill An unoccupied manual wheelchair or equivalent for the tester to push. 	As above	As above
23. Ascends 5° incline	<ul style="list-style-type: none"> Incline at least 2.5m long and at least 1.2m wide. A lip and a handrail on both sides of the incline are desirable. The incline should end at the upper end on a level surface or platform that is large enough for wheelchairs of all types, caregivers 	Level, 2 rulers	B

	and WST personnel to turn around safely (2.0m ² or more is recommended). A 15cm-high lip around the open edges of the platform is recommended. • Minimal floor-incline lip.		
24. Descends 5° incline	• As for the “ascends 5° incline” skill.	Level, 2 rulers	B
25. Ascends 10° incline	• As for “ascends 5° incline” skill, except 10° incline at least 1.0m long and at least 1.2m wide.	As above	As above
26. Descends 10° incline	• As for “ascends 10° incline” skill.	As above	As above
27. Rolls 2m across 5° side-slope L&R	• Incline of 5°, 2m long (in the line of progression) and at least 1.2m wide. • Means of monitoring if the wheelchair drifts downhill by greater than 10cm from the starting position. The slope-level transition can be used, or any line parallel to it. • Start and finish lines perpendicular to the line of progression. • At least an extra 1.5m before the starting line and beyond the finishing line.	As above	As above
28. Rolls 2m on soft surface	• Pathway with soft surface 1.5m wide and 2.0m long. • There should be an additional 1.5m of soft surface before the starting line and 1.5m beyond the finishing line (which need not be on the soft surface). • Options for the soft surface include gravel (medium-grade, 5 -6 cm deep), sand (fine grain, 5-6cm deep) or a gym mat (10cm thick).	Wheelchair, tape measure, tape	A
29. Gets over 15cm pot-hole	• Smooth level surface 1.5m wide, with at least 1.5m before and after the pothole. • The pothole should be ~5cm deep, the full width of the runway and 15cm across (in the line of	Wheelchair, tape measure, ruler	A

	progression).		
30. Gets over 2cm threshold	<ul style="list-style-type: none"> • 2cm high, 1.5m wide and 10 cm across (in the line of progression), rectangular in cross-section (i.e. a vertical front face). • The threshold should be secured so that it can withstand horizontal forces. 	Ruler, tape measure	A
31. Ascends 5cm level change	<ul style="list-style-type: none"> • The pathway leading up to the level change, below and above the change should be at least 1.5m wide and at least 1.5m long. The minimum run-up available before the level change ascent should be 3m, for subjects who use the momentum method. • The level change should be 5cm high. • The nosing of the level change should be gently rounded and covered with a non-slip material (e.g. gritted paint). • If needed, bracing or weighting is used to prevent the level change from moving when struck by the wheelchair. 	Ruler, tape measure	A
32. Descends 5cm level change	<ul style="list-style-type: none"> • As for “ascends 5cm level change” skill (#5.31) except, because many subjects can descend level changes from a higher level than they can ascend, some alternative means (e.g. an incline) of getting to the top is recommended. Alternatively, the WSP personnel can help get the wheelchair to the upper level. 	As above	As above
33. Ascends 15cm curb	<ul style="list-style-type: none"> • As for “ascends 5cm level change” skill except 15cm high. 	As above	As above
34. Descends 15cm curb	<ul style="list-style-type: none"> • As for “ascends 15cm curb” skill. 	As above	As above
35. Performs 30s stationary wheelie	<ul style="list-style-type: none"> • As for “turns 180° in place” skill. 	Tape measure, tape, chalk, string	A and C
36. Turns 180° in place in wheelie	<ul style="list-style-type: none"> • As for “turns 180° in place” skill. 	As above	As above

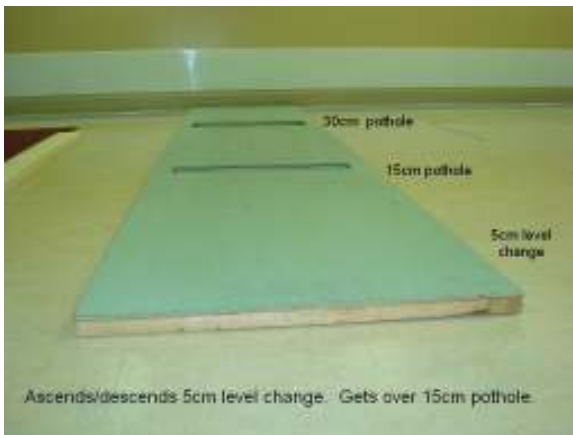
position L&R			
37. Gets from ground into wheelchair	<ul style="list-style-type: none"> • Smooth level surface. 	None	None
38. Ascends stairs	<ul style="list-style-type: none"> • There should be 3-5 stairs, with an 18cm rise, a 28cm run/tread and a width of 1.2m. • Rails should be available on both sides, at a height 86-92cm above the steps. The rails should extend beyond the upper and lower stair boundaries by 30cm or more. • The set of stairs should end at the upper end on a level surface or platform that is at least 1.5m². A 15cm-high lip around the open edges of the platform is recommended. 	Ruler, tape measure	A
39. Descends stairs	<ul style="list-style-type: none"> • As for “ascends stairs” skill. • Because it is often possible to descend stairs that cannot be ascended, an alternative means (e.g. a ramp, lift or test personnel) should be available to allow the wheelchair to get to the top of the stairs. 	As above	As above















Toronto Rehab Institute:







LOW-TECH MEASUREMENT METHODS

The following section enables users to measure distances, find slopes, and determine perpendicular lines to evaluate or construct an obstacle course to test the WSP 4.1.

Materials:

Tape measure
Bubble level
24'' Bubble level
Straight edge accurate to 1/32'' or 1mm
String
Chalk
Masking/electrical tape
Pocket calculator
Wheelchair (use as pace wheel)

Instructions:

A. Measuring Distances

Measure distances using the tape measure or ruler for short distances when appropriate, or using the wheelchair as a pace wheel for longer distances.

To use the wheelchair as a pace wheel, Subdivide the hand-rim of the wheel into quarters, eighths, or sixteenths (depending on the sensitivity you wish to measure to) and mark with tape. Color one of the taped sections (e.g. with a pen) to serve as the index marker. Put the index marker at the bottom, dead center, over the starting point of the distance you wish to measure.

Table 1: Wheel circumference chart

Wheel Diameter		Circumference	
in.	cm.	in.	m.
20	50.8	62.83	1.60
24	60.96	75.40	1.92
26	66.04	81.68	2.07

To determine the number of revolutions of the wheelchair wheel required, take the distance you want to measure, and divide by the circumference (found in Table 1), of your wheel (Equation A1).

$$\# \text{Revolutions} = \frac{\text{Required Distance}}{\text{Circumference}} \quad (\text{A1})$$

For instance, if you want to measure 100m, using a wheelchair with a rear-wheel diameter of 24'', the # of revolutions needed is:

$$\# \text{Revolutions} = \frac{100 \text{ m}}{1.92 \text{ m}} = 52.1 \text{ revs}$$

Alternatively, if you know the number of revolutions and want to know how far you've gone, use the following equation (Equation A2);

$$\text{Distance Traveled} = \# \text{Revolutions} \times \text{Circumference} \quad (\text{A2})$$

For instance, if you have made 5 revolutions with a rear-wheel 20'' in diameter, the distance you have traveled is:

$$\text{Distance Traveled} = 5 \times 1.60 \text{ m} = 8 \text{ m}$$

These relationships are presented in Table 2. The user can find the specific number of revolutions required given the distance required and the size of the wheel used.

Table 2: Relationship between distance, wheel diameter, and # of revolutions

Distance required (m)	For 20'' wheel	For 24'' wheel	For 26'' wheel
	# Rev.	# Rev.	# Rev.
5	3.13	2.60	2.42
10	6.25	5.21	4.83
100	62.50	52.08	48.31

B. Measuring Slopes

Measure slopes using the bubble level and straight edge. The 2 are combined in Figure 1. Make sure one end of the bubble level is contacting the slope, and it is level (horizontal, as indicated by the bubble). Holding the small ruler vertically, complete the right angle triangle formed by the ramp, level, and ruler. Take note of the distance (X) between the lower end of the level and the ramp. Refer to the Table 3, 3.5, or 4 (for horizontals of different lengths) to find which slope value this best represents.

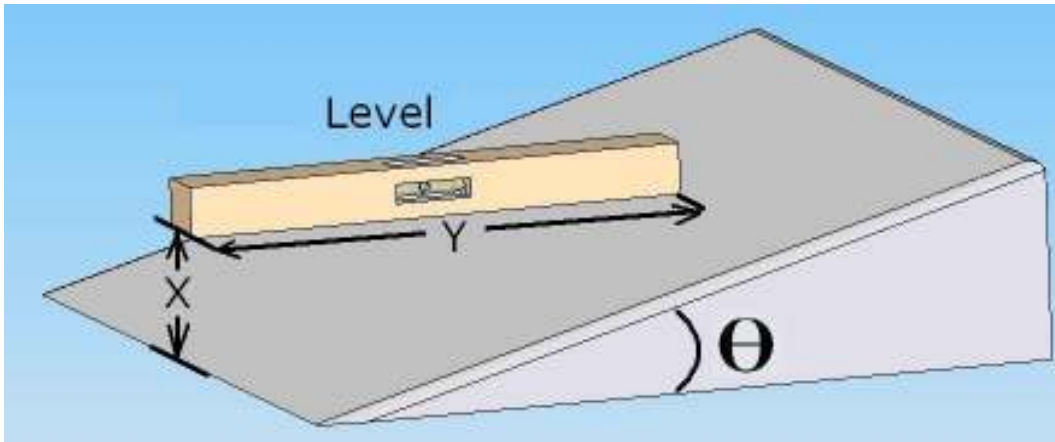


Figure 1: Orientation of level to measure slope of ramp

The slope in degrees (angle Θ) is determined by using the trigonometric function shown below (Equation B1).

$$\text{Tan } \Theta = X/Y \quad (\text{B1})$$

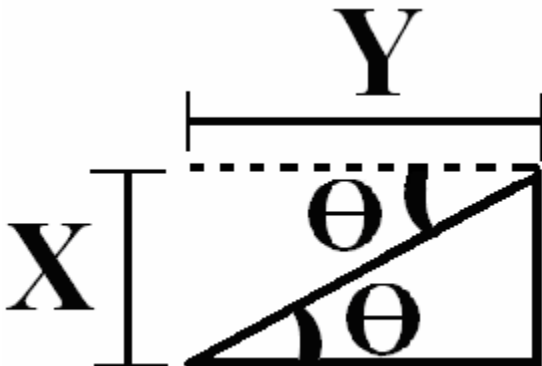


Figure 2: Z-theorem

The Z-theorem states that a “Z” consisting of two parallel lines of equal length has equal angles as shown in Figure 3.

Table 3 was produced by using the trigonometric function shown above (B1) and the Z-theorem (Figure 2). The resultant angle is described in terms of degrees, percent and as a ratio (Tables 3, 3.5, and 4).

Table 3: Slope measuring chart (Imperial distance measures [inches])

X	Y*	Θ (Degrees)	Θ (Percent)	Θ (Ratio)
8/32''	12''	1.19°	2.08%	1:48
13/32 ''	12''	1.94°	3.39%	1:29.5
5/8''	12''	2.98°	5.21%	1:19.2
1''	12''	4.76°	8.33%	1:12
1 1/2''	12''	7.13°	12.50%	1:8
1 9/16''	12''	7.42°	13.02%	1:7.68
2''	12''	9.46°	16.66%	1:6
2 1/8''	12''	10.04°	17.71%	1:5.65

*This table is for a straight edge 12'' long.

Table 4.5: Slope measuring chart (Imperial distance measures [inches])

X	Y*	Θ (Degrees)	Θ (Percent)	Θ (Ratio)
1/2''	24''	1.19°	2.08%	1:48
26/32 ''	24''	1.94°	3.39%	1:29.5
1 1/4''	24''	2.98°	5.21%	1:19.2
2''	24''	4.76°	8.33%	1:12
3''	24''	7.13°	12.50%	1:8
3 1/8''	24''	7.42°	13.02%	1:7.68
4''	24''	9.46°	16.66%	1:6
4 1/4''	24''	10.04°	17.71%	1:5.65

* This table is for a straight edge 24'' long. This provides greater accuracy than Table 3.

Table 4: Slope measuring chart (Metric distance measures [cm])

X	Y[□]	Θ (Degrees)	Θ (Percent)	Θ (Ratio)
0.62 cm	30 cm	1.19°	2.08%	1:48
1.01 cm	30 cm	1.94°	3.39%	1:29.5
1.56 cm	30 cm	2.98°	5.21%	1:19.2
2.50 cm	30 cm	4.76°	8.33%	1:12
3.75 cm	30 cm	7.13°	12.50%	1:8
3.91 cm	30 cm	7.42°	13.02%	1:7.68
5.00 cm	30 cm	9.46°	16.66%	1:6
5.31 cm	30 cm	10.04°	17.71%	1:5.65

[□] This table is for a straight edge 30cm long.

C. Finding Perpendicular lines

- 1) Mark the point on the line at which you would like to draw a perpendicular line. This point will be referred to as the origin (X) as shown in Figure 3.



Figure 3: The origin is marked

- 2) Tie a loop in the string to put the chalk in. Knot off a length of string (about 20-40cm).
- 3) Using the string as a compass, anchor one end to the origin. Using the chalk, mark off equal lengths on either side of the origin (Figure 4).

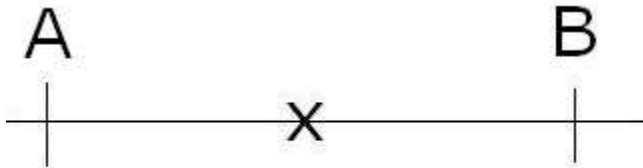


Figure 4: Point A and B are marked at equal distances from the origin

- 4) Using the string and chalk, anchor the string at point A and draw an arc or a full circle. The length of the string should be slightly longer than for the previous step. Repeat for point B, using the same length of string. The intersection of the two arcs is referred to as C (Figure 5).

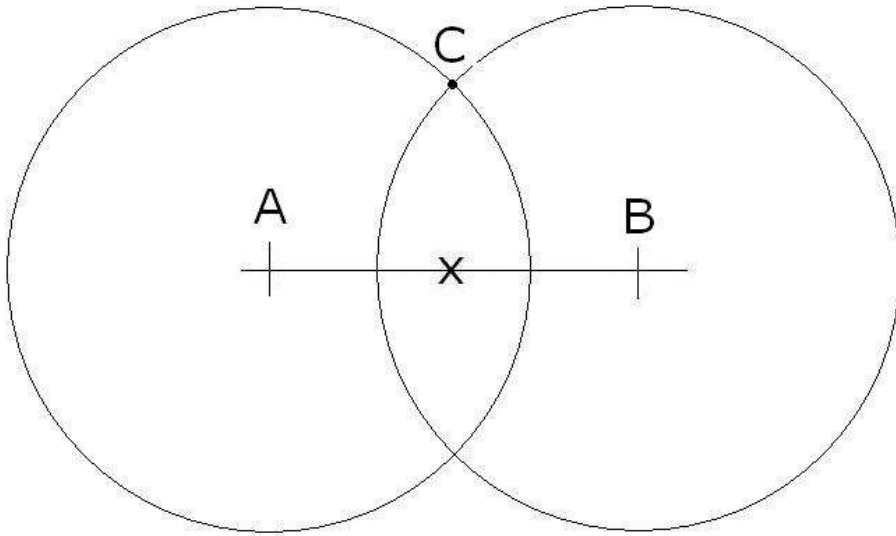


Figure 5: Arcs of equal radius drawn about point A and B

- 5) Connect the point C to the origin to produce your perpendicular line (Figure 6).

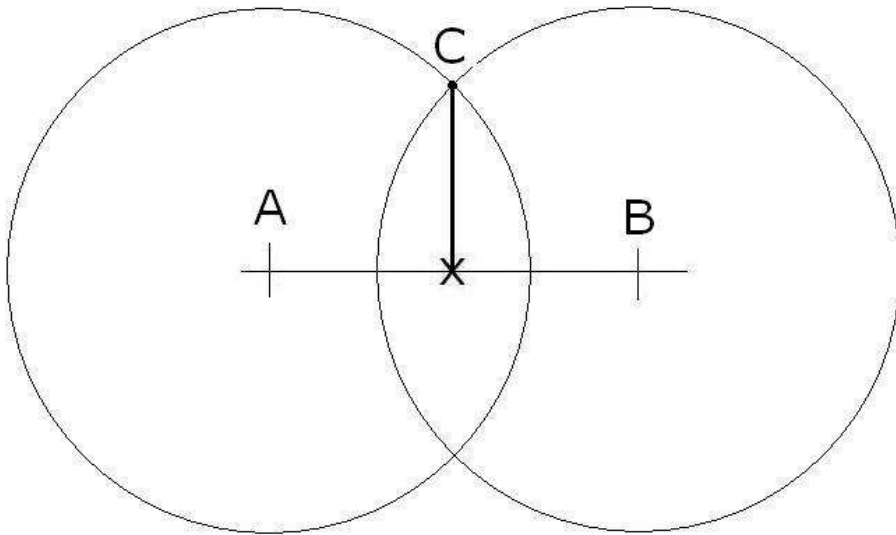


Figure 6: Perpendicular line drawn by connecting point C to the origin