Long Jump Model

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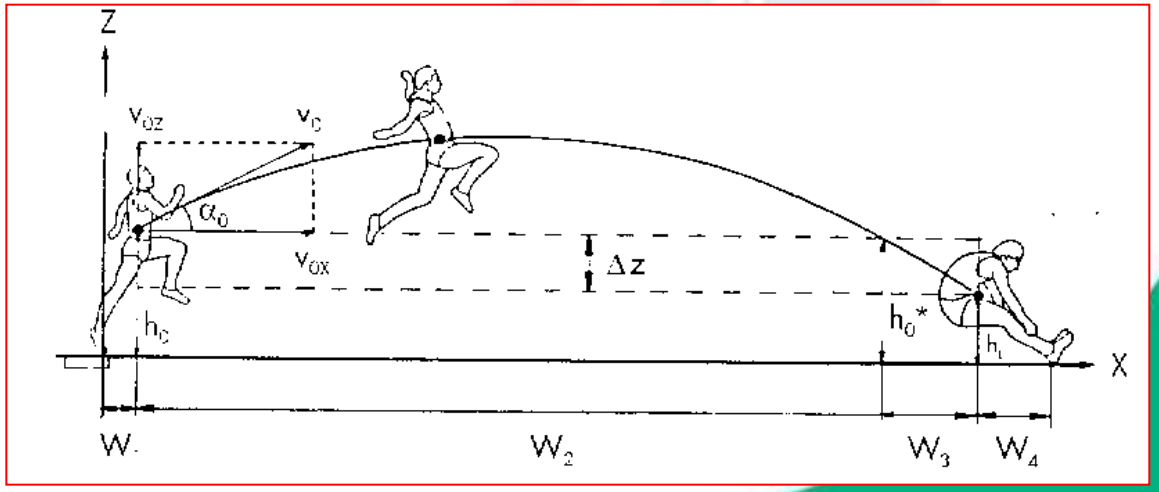
Kinematic of long jump

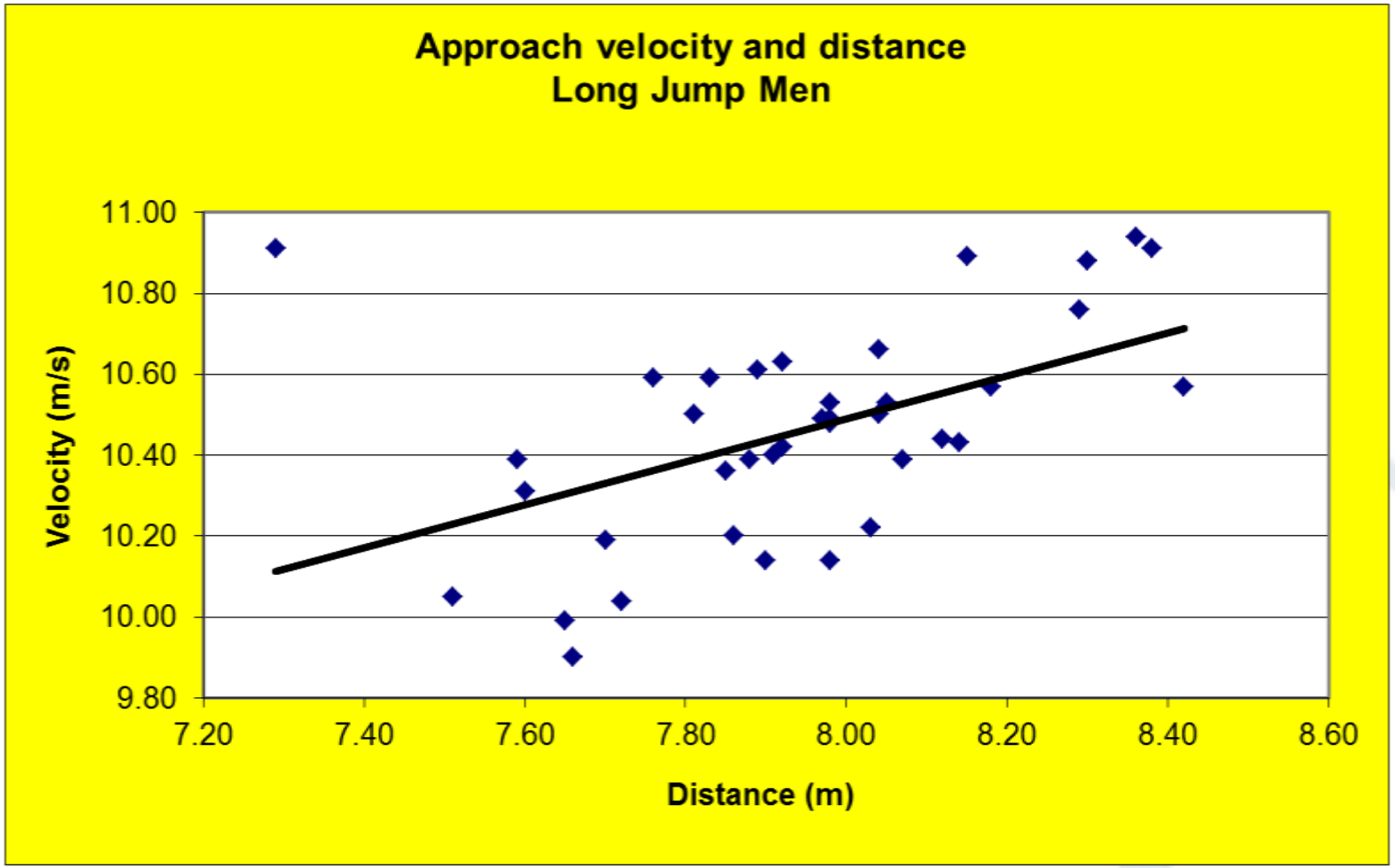
- V_x = Horizontal velocity
- V_y = Vertical velocity
- V_o = resultant velocity (when the athlete leaves the ground)
- α = angle of flight
- h = height of flight
- W^4 = landing efficiency

$$L = \frac{Vo^2.\sin 2\alpha}{g}$$

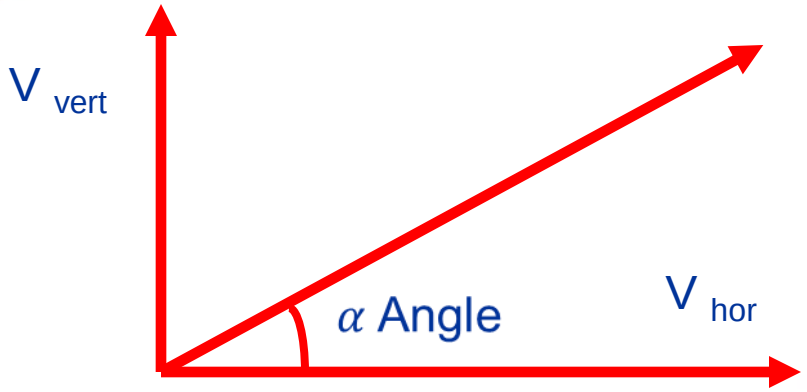
Biomechanical model



RUN UP SPEED


Approach velocity and distance
Long Jump Men
Velocity (m/s)
11.00
10.80
10.60
10.40
10.20
10.00
9.80
7.20
7.40
7.60
7.80
8.00
8.20
8.40
8.60
Distance (m)

Take-off velocities WC 1997



Type equation here.

Athletes	Result [m]	Run-up Speed [m/s]	V hor [m/s]	V vert [m/s]	Take-off Angle α
Pedroso	8,42	10,82	8,72	3,86	24
Walder	8,38	11,12	9,29	3,31	20

CONSIDERATIONS

- The faster the run-up the shorter the contact time at the board
- The shorter the contact time the less time to produce vertical take-off velocity
- The less vertical take-off velocity the smaller the take-off angle
- Consequences: With increasing run-up speed athletes must develop their reactive strength qualities

Trend of Horizontal jumps results

- *Average of the 10 best athletes:*

- Long Jump men:

1991	2001	2006	2007	Beijing 2008
8,437m	8,287m	8,401m	8,387m	8,12m (96,8%)

- Triple Jump men:

17,564m	17,390m	17,513m	17,528m	17,24m (98,4%)

- Long Jump women:

7,08m	6,926m	6,964m	6,997m	6,741m (96,3%)

- Triple jump women:

14,148m	14,693m	14,835m	14,909m	**14,946m (100,3%)**

Analysis of Long Jump in Beijing

- Men:

- a) qualification: last qualified with 7,94m.
- b) final: 35% no jump out of 60 total jumps;
  winning jump: 8,34m, silver 8,24m and bronze 8,20m.

- Women:

- a) qualification: last qualified with 6,59m.
- b) in final, 4 out of the 12 qualified did not perform better than 6,49m:
  Maggi gold and Lebedeva silver jumped 7,04m and 7,03m respectively; Agagbare (NIG), got the bronze medal, despite being the last qualified athlete she jumped 6,91m, which represents her Personal Best (before her PB was 6,86m)

Planning and Annual Periodisation

Planning:

Normally coaches plan a four year cycle (Olympiada), fixing progressive objectives to be achieved each year in order to realize the final goal: “to win a medal”.

Periodisation:

Normally the sport season represents the basic cycle.

We can have a “simple” periodisation: only one competition cycle in a year, which is applicable at Youth level.

Elite athletes normally use a multiple periodisation: (two or three competition cycles in a year)

Performance Plan for London 2012

- Athlete identification: X / Y
- Performance objectives for London

a) To qualify: man, 8.20m (A) 8.10m (B)

woman, 6.75m (A) 6.65m (B)

b) To win a medal: man, 8.40m

woman, 6.80m

- Current performance level: X: 8.28m / Y: 6.65m

Periodisation

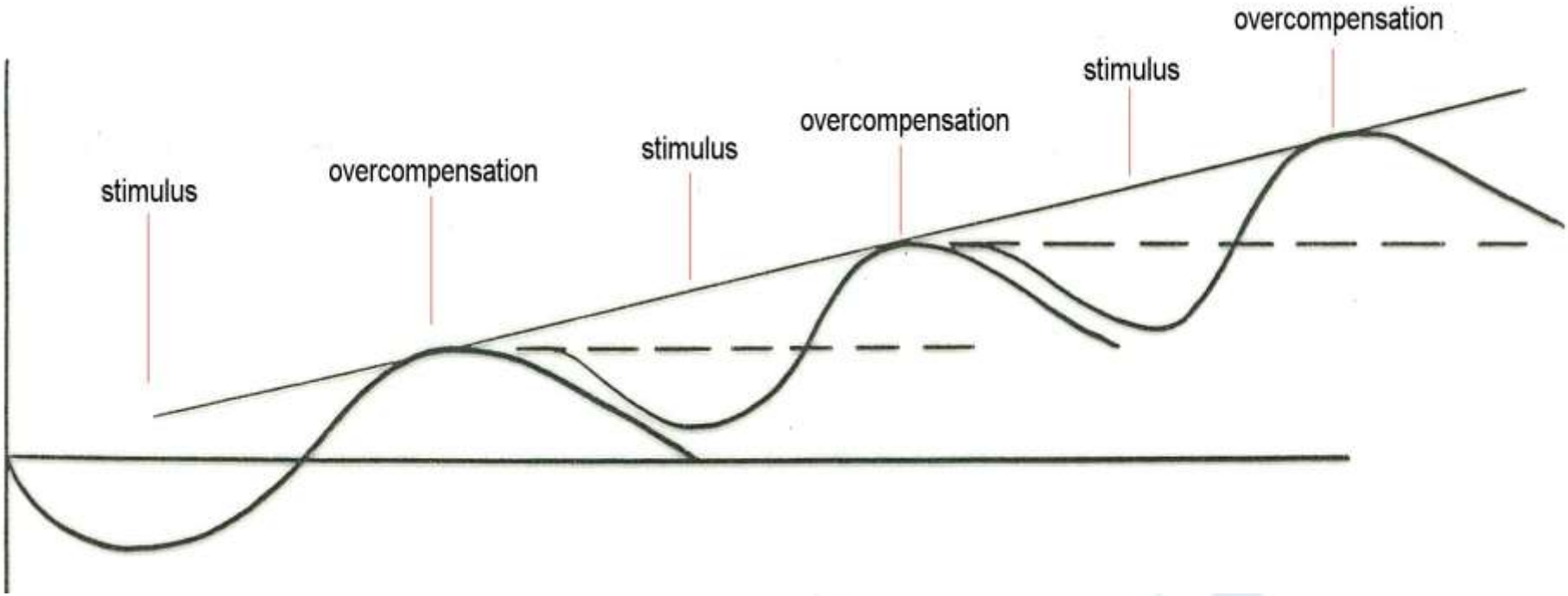
The Structure of the annual periodisation:

1)Macrocycle: covers the all year in the case of a simple periodisation or can be devided into two macrocycles (indoor / outdoor), if the athlete decides to focus in both.

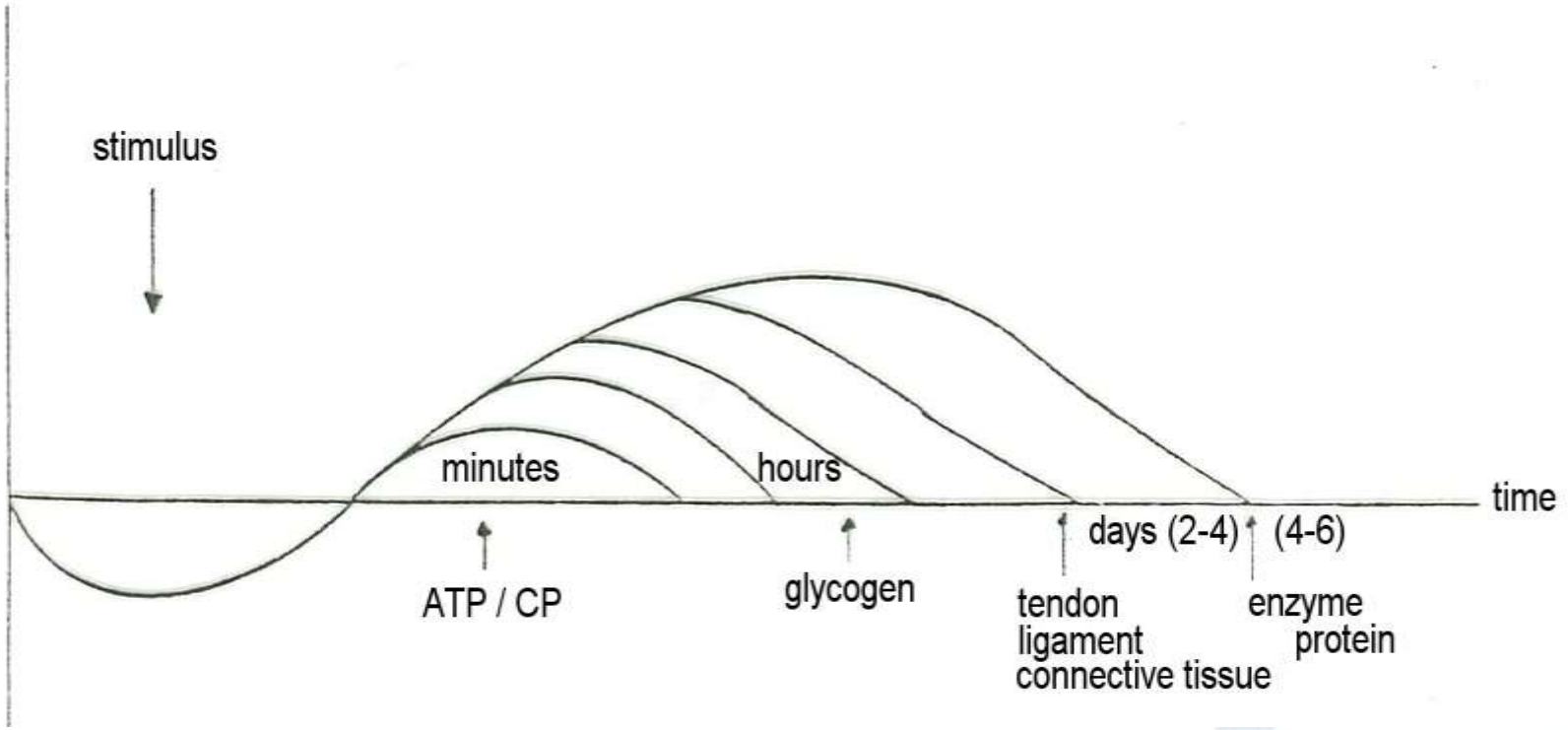
2) Mesocycle: normally covers 6 weeks in the general preparation period and 4 during the special training cycle.

3) Microcycle: normally covers 1 week and should be repeated for the duration of each specific mesocycle.

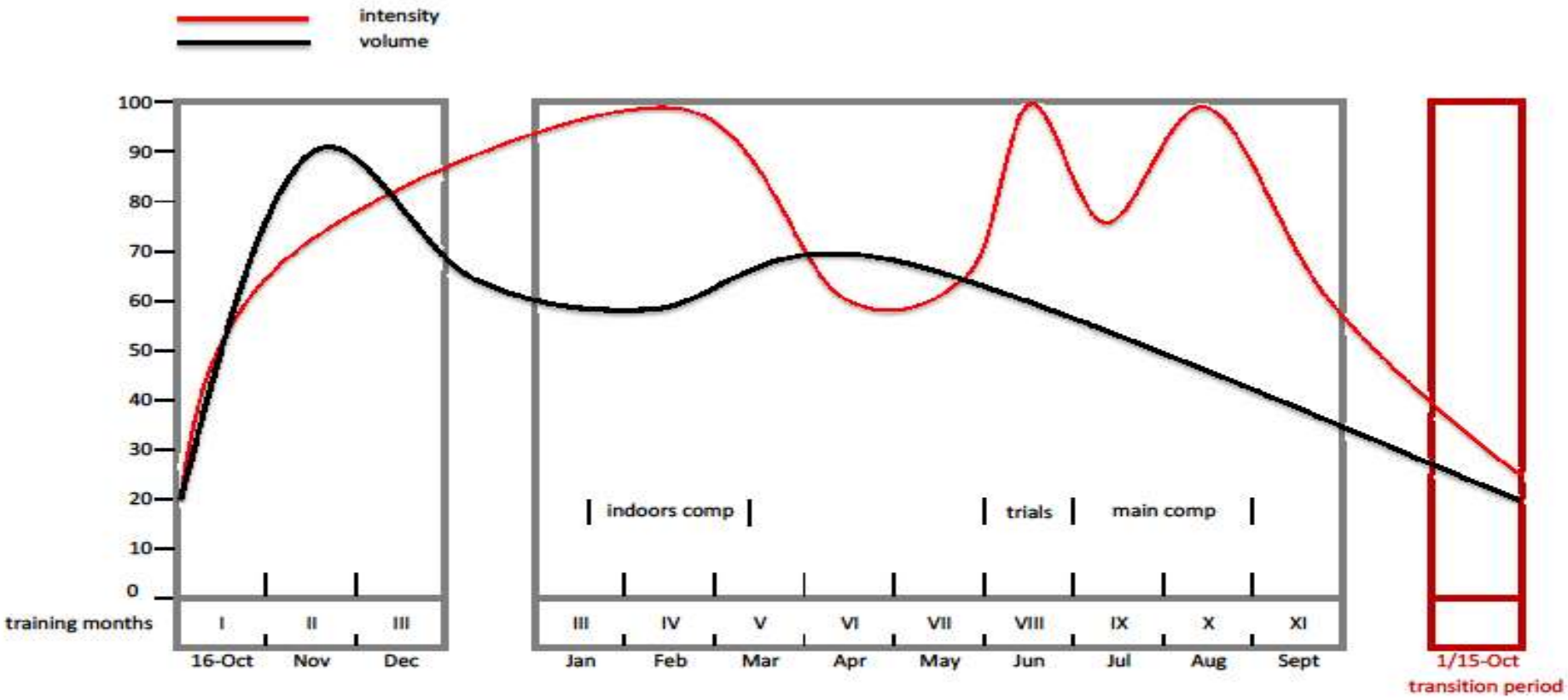
Overcompensation Laws



Reconstitution of the various organs and body systems after a training stimulus



Example of load distribution in a Macrocycle (Top athlete)



Example of Microcycle (PPS) (Top Athlete) 1

Monday	Tuesday		Wednesday
Warm-up Technical running exercises with loads (ankle weights and belts) Short bounds: a) 10 standing long-jumps b) 8x2 c) 6x3 d) 4x5 **Speed endurance** (lactic capacity) 2x (100/150/200/300)	*Morning*	**Strength training** Jerk with squat under Snatch Half-squat (pyramid) Step-up 4X10 with body weight Standing calf-raise 3x20 with 200% body weight	Warm-up Technical running exercises Skill an speed exercises over hurdles Running acceleration **Speed endurance** (lactic power) 5x5x60m – recovery between repetitions 1'30" recovery between sets 6' loads vary between 90-92% body weight
	Afternoon	Warm-up Reactivity Imitation jumps Technique: 20 complete jumps with 6-8 run-up strides **Throws** (backwards and forwards) 20 throws with 6 – 7 Kg.	

Example of Microcycle (Top Athlete) 2

Thursday		Friday	Saturday		Sunday
Morning	**Strength training** Squat with squat under Cleans Quick half-squat: 6x10 with 200% body weight Half-squat jump with bounce 6x6 with 100% body weight	Stretching warm-up Technical running exercises with loads (ankle weights and belts) Long bounds: a) 6x5 b) 6x10 **Speed endurance** (lactic capacity) 3x100m 3x150m – 3x100m	*Morning*	**Strength training** According to individual requirements	Rest/ Regeneration
Afternoon	Stretching warm-up Repeat Tuesday schedule		*Afternoon*	Stretching warm-up Speed exercise Short and long bounds **Speed endurance** (lactic power) 3x (60-80-100m)	

TRAINING PERIODISATION for CHEIKH TOURE (INDOOR) 1996/97

1st Macrocycle: 23/10 - 28/2 (17 weeks)

MAC	MES	MIC	DATE	CONTENTS	CONTROL	COMP
I	I	1	23/10-29/10	Introduction Cycle:		
		2	30/10 - 5/11	aerobic power Develop.		
		3	6/11 - 12/11	general strength		
	II	1	13/11 - 19/11	General Fundamental Preparatory Cycle:	Test: 9/12	
		2	20/11 - 26/11	speed endurance and power Develop.	(L/T/Q)	
		3	27/11 - 3/12	nb: 2nd week rest (dakar)	bonds	
		4	4/12 - 10/12	explosive and maximum strength		
		5	11/12 - 17/12			
	III	1	18/12 - 23/12	General Intensive Preparatory Cycle:		
		2	27/12 - 31/12	sprint + speed res. Develop.	14/12	
		3	3/1 - 7/1	Max Strength + explosive strength	Bosco test	
				nb: from 30/12 to 2/1 rest	+ squat	
				technique: jumps with 6-8-10 steps		
	IV	1	8/1 - 14/1	Special Cycle:	21/1	
		2	15/1 - 21/1	max. speed develop.	reactivity	1 comp
		3	22/1 - 28/1	explosive and reactive strength	test	regional
		4	29/1 - 4/2	technique (full jumps)		28/1
	V	1	5/2 - 28/2	Indoor competition Cycle		5 comp
						Nat / Intl
		1	1/3 - 21/3	Transition Cycle		
				2 weeks active rest + 1 week of general training at 50%		

TRAINING PERIODISATION for Giovanni Evangelisti 1991
2nd Macrocycle - 25/3 - 22/9 - (26 weeks)

MAC	MES	MIC	DATE	CONTENTS	CONTROL / TRAINING CAMPS	COMP
II	I	1	25/3 - 31/3	General Preparatory Cycle II:		
		2	1/4 - 7/4	Max Strength + explosive strength	Formia (1/4 - 7/4)	
		3	8/4 - 14/4	Anaerobic and Aerobic Capacity		
		4	15/4 - 21/4			
		5	22/4 - 28/4		Oristano (29/4 - 5/5)	
		6	29/4 - 5/5			
	II	1	6/5 - 12/5	Special Cycle II:		11/5 Trento
		2	13/5 - 19/5	Max Strength + reactive strength		8m11
		3	20/5 - 26/5	Anaerobic Power		
		4	27/5 - 2/6	Technique	Schio (27/5 - 2/6)	
	III	1	3/6 - 9/6	First Competitions Cycle:		
		2	10/6 - 16/6	max. speed develop.		
		3	17/6 - 23/6	technique		NB: from 2/6
		4	24/6 - 30/6			to 20/6 injured
		5	1/7 - 7/7			
		6	8/7 - 14/7		Salsomaggiore (24/6 - 29/6)	European Cup 3rd 7m79
		7	15/7 - 21/7			4/7 Udine 8m13
	I	1	22/7 - 28/7	Regeneration cycle	Formia	
		2	29/7 - 4/8	Max Strength + explosive strength		
	II	1	5/8 - 11/8	Cycle of Fundamental Competitions		
		2	12/8 - 18/8	Reactivity, Speed, Technique	Grosseto (7/8 - 10/8)	Tokyo:
		3	19/8 - 25/8		11/8 8m11	Qualif: 30/8 OK
		4	26/8 - 1/9		NB: 14/8 departure for Tokyo	Final: 31/8 (7th with 8m01)
		5	2/9 - 8/9			Bologna 8/9: 8m35 +3.5m/s
		6	9/9 - 15/9			

Example of a microcycle: Preparatory Cycle II (C. Toure: 23 March–30 Apr. 1997)

Monday:

- Technical jump drills and imitations
- Technique: 12-15 jumps, 5-7 strides
- Short Bounces:

6L: from standing

6B: from standing

6T: from standing

-Speed endurance:

3x4x60m. (~6"7)

(rec. 2' et 5')

Tuesday:

Morning: Strength training

- Snatch: 4x4x70-80kg
- Squat:

2x6x120kg

1x5x130kg

1x4x140kg

1x3x160kg

- Step-up: 2x10x40kg

-Take-off/step:

3x30m with barbell of 30kg

Afternoon:

- technical sprint exercise (skip, etc…)
- Harnes:6-8x30m (~4"8) rec.4'

Wednesday:

- Plyometrics:

6x6hs - 1m int. (h = 91cm)

-Long Bounces:

6 time 5 hops (3dx/ 3sx)

4 time 10 jumps (altern.)

- Speed endurance:

3x100 /80 /60m

rec. 5' e 4' and 8' between

Throws: 15 with 6kg

(backward and forward)

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Thursday

Morning: Strength training

- Snatch: 4x4x70-80kg
- 1/3 Squat-jump:
  6x8-6rep. with 100-120kg
- Calf-rise: 3x20x120kg
-Take-off / step:
3x30m with barbell: 30kg

Afternoon:

As Tuesday but changing sprint drills with Technical jump drills

Friday:

- Plyometrics:
6x6hs - 1m int. (h = 91cm)
-Sprint drills:
- Sprint starts (from blocks)
6-8x30m
- Technique:
6 jumps with 7 strides
6 jumps with 9
6 jumps with 11
- Throws: 15 with 6kg
(backward and forward)

Saturday:

- Sprint frequency drills
3x15" skip
3x15" kick-back
3x30m frequency sprint runs
- Speed endurance
3x100m (rec.4')
t ~10.5"
rec. 8'
2x150m (rec.5')
t ~16"
rec. 10'
1x300m (t~36")

Sunday: Rest

Strength Training

- Definition of strength:

  Is the capacity of the skeletal muscle to produce "tension" when stimulated.

  The strength of a muscle depends on its "section".

- In Sport literature we distinguish the following strength expressions:

  - Maximal dynamic strength
  - Explosive strength
  - Reactive strength

Different types of muscle action:

Concentric - the muscle is in tension and shortens.

Isometric - the muscle is in tension, at a constant length.

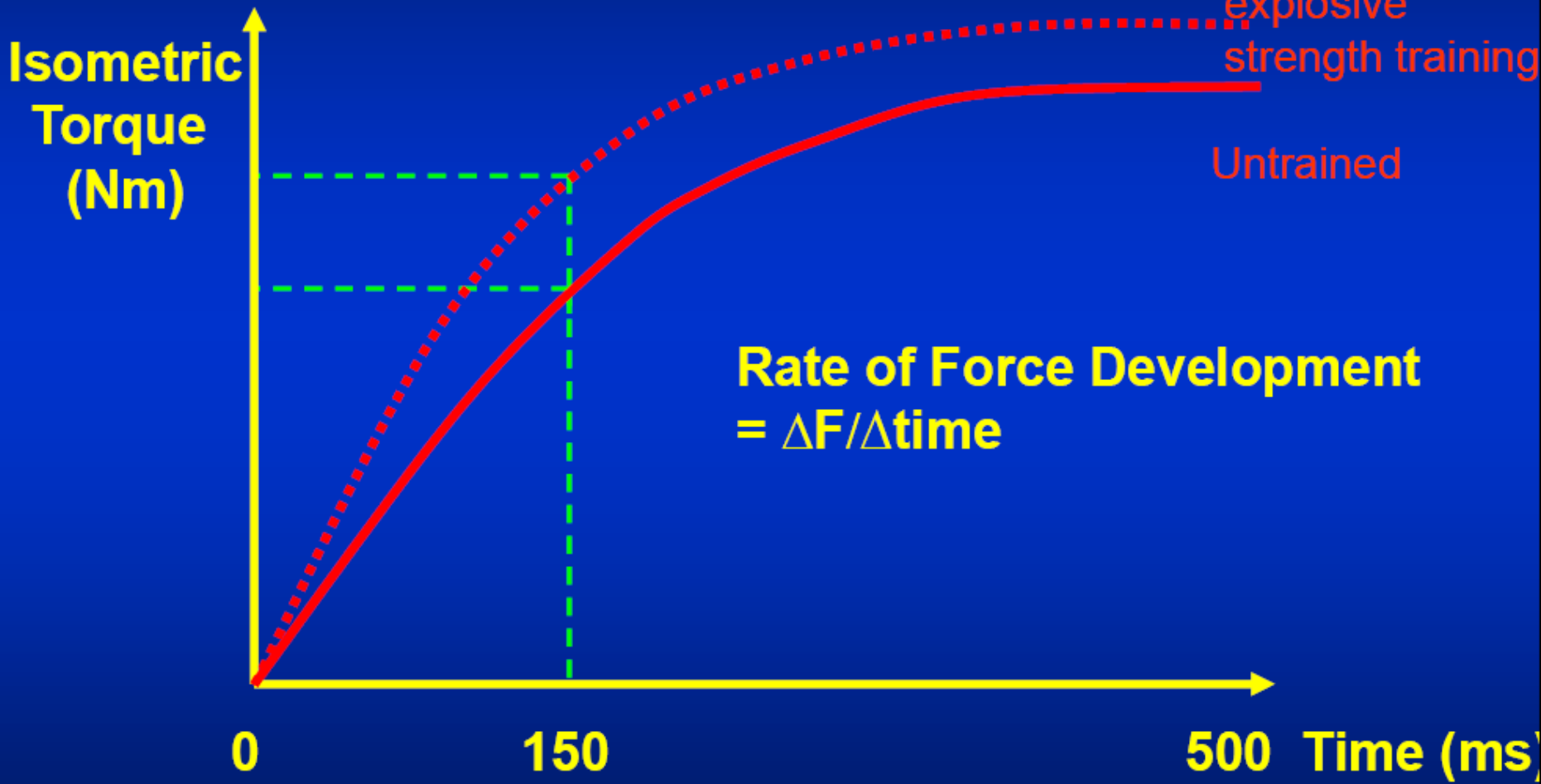
Eccentric - the muscle is in tension, but it lengthens.

The Stretch Shortening Cycle

"An eccentric muscle action immediately followed by a concentric muscle action."

Enhanced concentric performance if immediately following an eccentric muscle action.

Rate of Force Development



Hakkinen et al., 1985

Factors that determine Muscle Performance.

Training Variables for Strength Training

e.g. 4 sets of 10 reps @ 10RM (24 kg)
with 2 mins rest between sets
2 × per week.
8 exercises: bench press, calf raises…

Frequency	Days per week
Intensity	Load
Time	Reps & Sets
Type	Exercise & Muscle group (machines vs free weights, type of muscle action, Range of motion)

Loading - The Repetition Maximum

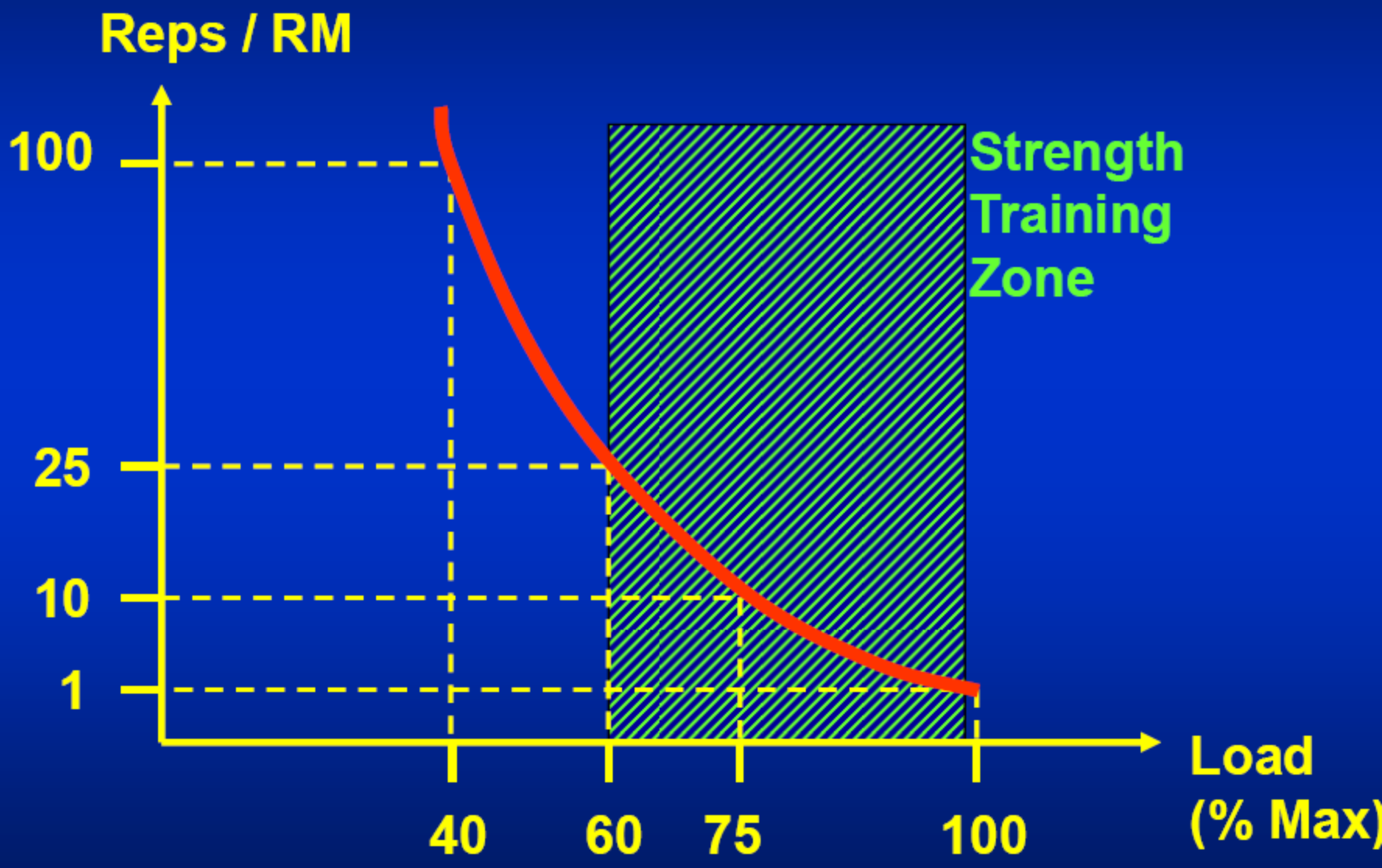
Maximum lift = 100 % = 1 Repetition Maximum (1 RM)

- the load that can just be lifted once.

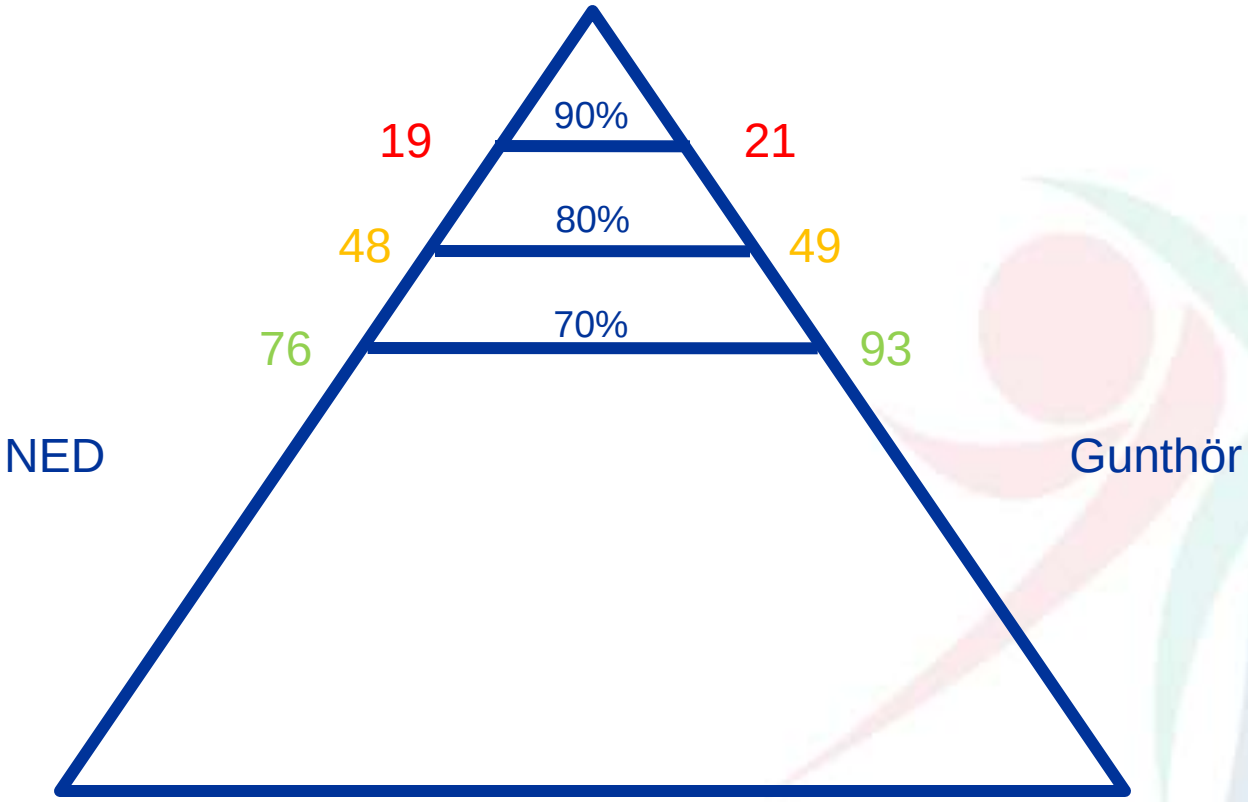
10 RM – the load that can just be lifted 10 times.
= approx. 70-75 % max force.

As any RM is a relative loading (relative to a person's ability) it facilitates progressive overload.

Loading vs Reps



Capacities of “Top” athletes



J.P. Egger (1994): Athletes: Gunthör & NED

Loading & Strength Increases

In a recent review Rhea et al. (2003) agreed that > 60% was required for previously untrained to increas strength.

Widely accepted by scientists & practitioners.

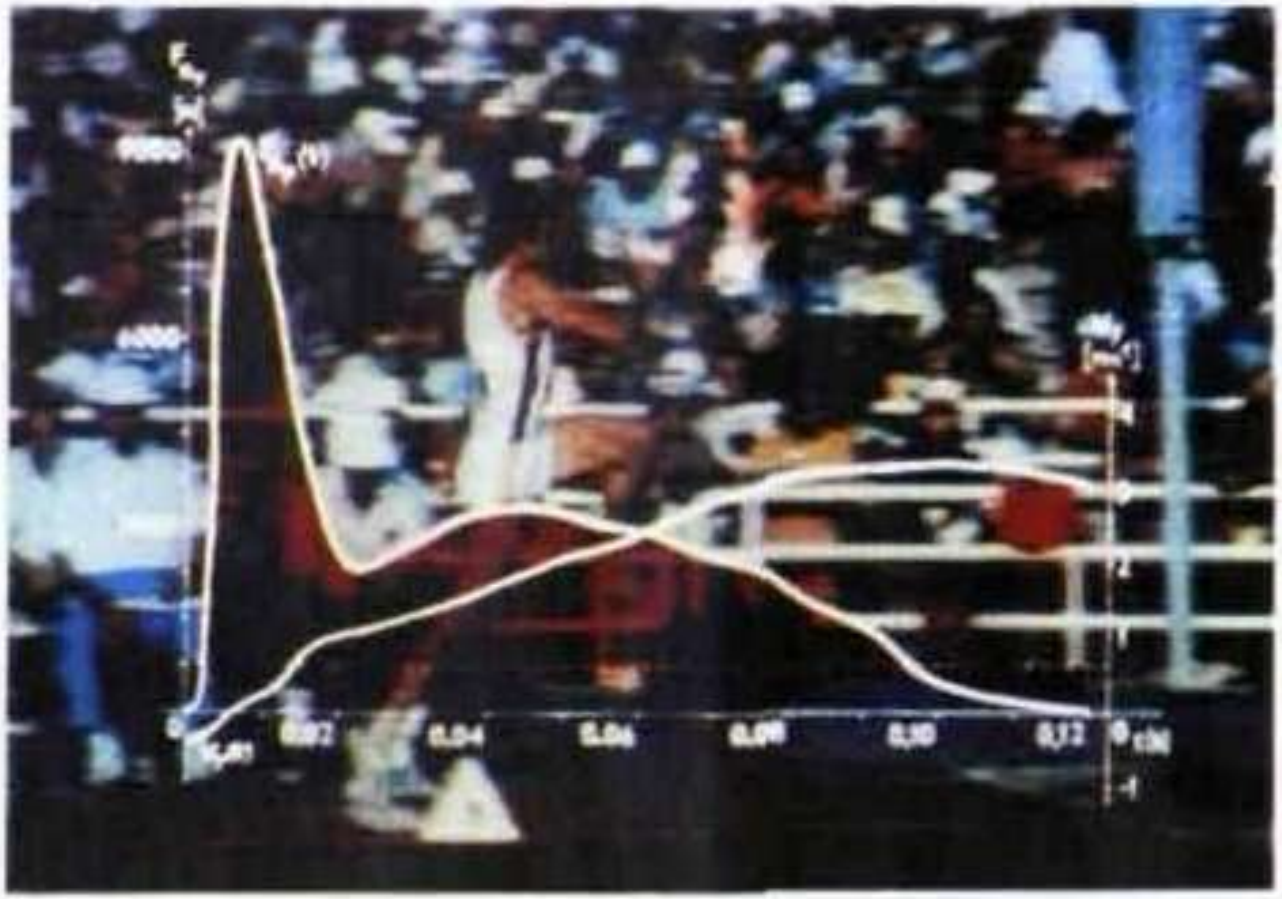
But Rhea et al. (2003) suggested > 80% was optimal for ↑ strength in well-trained (>1yr of training).

Strength training for horizontal jumps:

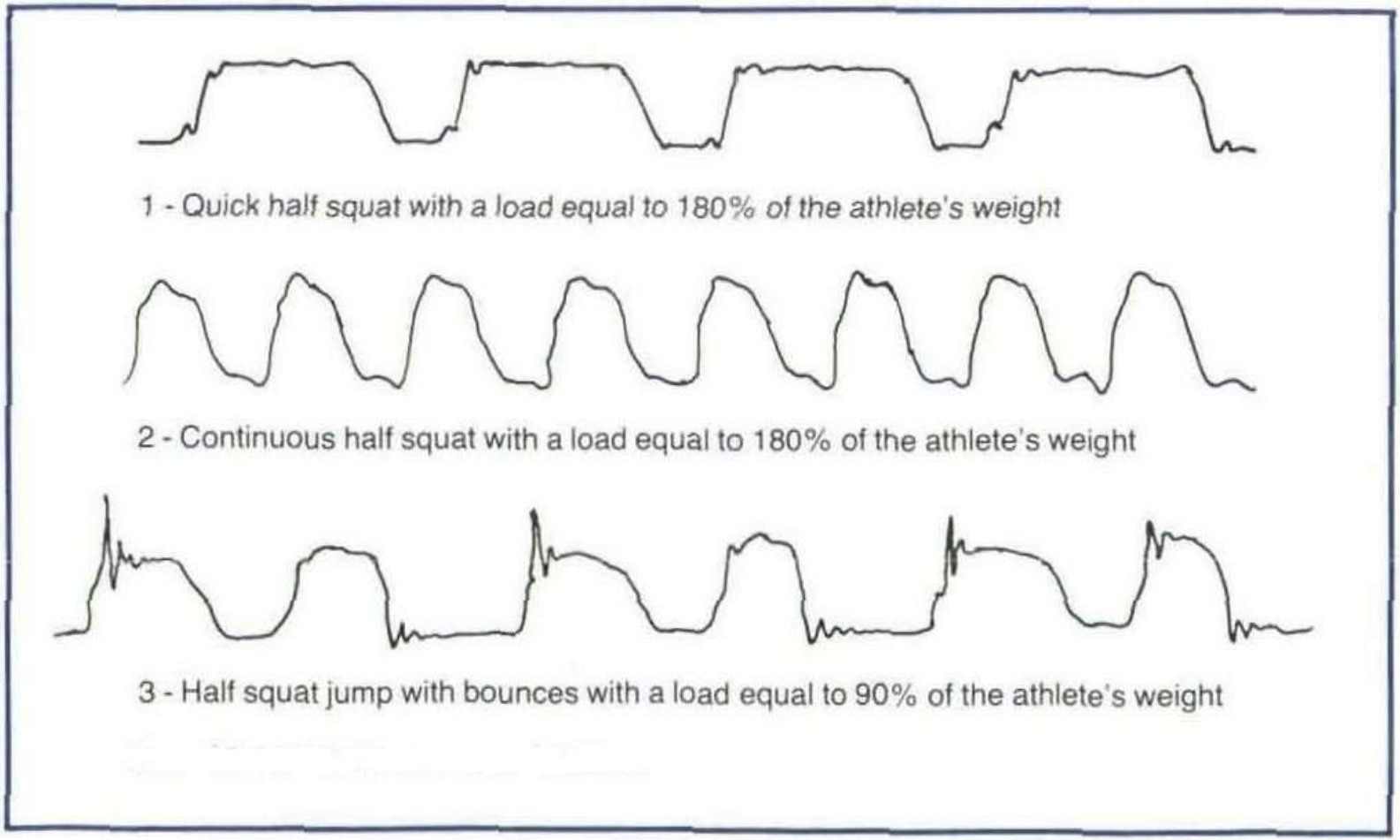
- Specific to the event
- **Individualised**
  - Intensity (varies with the cycles)
- Volume (only with the general preparation cycle)
- Tested every 6 weeks (Bosco tests)
- Safe (teaching exercising technique properly)

Long Jump

- Strength curve recorded at take-off

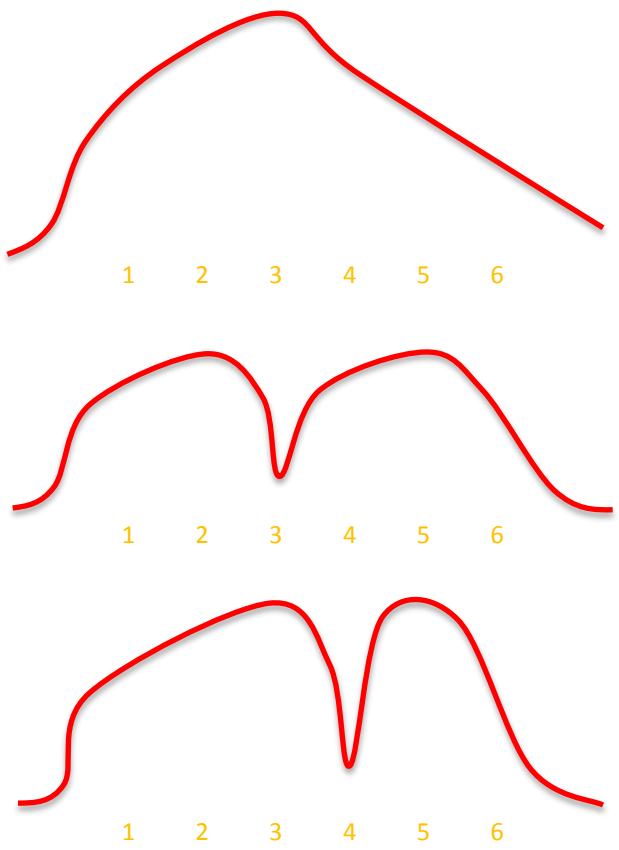


Strength curve recorded when doing basic strength execises (1- Quick ½ squat / 2 -½ squat jump and 3-½ squat jump with bounce)



- Strength curves of the three basic exercises (quick half squat, half squat jump and half squat jump with bounces) recorded on the force platform with Goul apparatus

TRAINING CONTROL



Normally at the end of each mesocycle (4 -6 weeks)

Examples of Load distribution in each microcycle:

- 5 :1 (Test)
- 2:1 – 2:1 (Test)
- 3:1 - 1:1 (Test)

Technical Tests

(Cheikh Toure: 1996-99)

Date	Long Jump	Triple Jump	5 Jumps	10 Jumps	Throws (7 kg back)
1996	3m36	9m75	17m35	35m50	17m20
1997	3m38	10m20	18m05	36m80	18m40
1998	3m45	10m25	18m40	37m40	18m80
1999	3m47	10m35	17m80	36m50	

Best performance in long jump with short run up:

7 steps	6m75
9 steps	7m20
11 steps	7m55
13 steps	7m86

Best performance in sprint (training: manual timing):

60m	6"3
80m	8"2
100m	10"1
150m	15"4

Run up: 19 or 21 steps. Last 6 steps (15m; time: 1"36-1"40)

Bosco tests

Squat jump	48cm	Reactivity	68 watt ($\frac{h.2g}{t}$)
CM jump	52.7cm		

BOSCO TEST

	Data	So	Scm	∆ So /Scm	Sbw	∆ F/V	REACTIVITY		
							h	ct	Watt
EVANGELISTI G.	27/1/84	52.6	57.6	5.0	23.6	0.448	70.5	155	89.2
CAMPUS M.	30/5/94	47.9	55.2	7.3	20.4	0.425	61.8	124	98.7
BUTTIGLIONE D.	15/5/94	48.1	54.8	6.7	22.9	0.476	63.5	159	78.4
MAY F.	15/5/94	44.2	51.1	6.9	17.6	0.398	55.8	154	71.1
CAPRIOTTI A.	15/5/94	42.9	46.1	3.2	16.8	0.392	52.0	159	64.2

STRENGTH TRAINING CONTROL: BOSCO TEST (1)

STRENGTH TRAINING CONTROL: BOSCO TEST (2)

Thank you for your attention

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