

Evaluation of the Operational Speed for Iraqi Railways Using Geomatics Techniques

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ABSTRACT

The research evaluation is the current operational speeds of Iraqi railway lines within Geomatics techniques. It aims improving operational speeds where fined the level of speeds in Iraq has reached in some places to (5 km/h) for the north line. Also determining the factors affecting the speed and causing the decline of the railway, such as soil, the old design of line, the large number of irregular crossings, bad maintenance of fences, means of communication is very bad and almost without safty fences, a single line, except some lines and some climate element which reflected negatively on the performance of the railway, the large number of accidents with operational speed of passenger trains ranged between (20-90) km/h at a time (10) hours for the south line, and (20-80) km/h for north line. it is improved by reducing the time on the orders of caution, time to enter and exit from the station, stop at the stations time, increasing operational speed up to (80-90) km/h, these improvements one possibly achieved by raising the irregular crossings or convert regular crossings to overpass, treatment of soil, good maintenance (for the rail lines, the protective fence), and the use of modern communication and signals system. A proposal to reduce the trip time from Baghdad to Basrah to (5.13) hour at a percentage 23% to (98-110.7) km/h(because it's the only working line) as in the case at India where a study for upgrading track standards of conventional track with diesel and electric traction which is close to the specifications of the reality case of the Iraqi railway nets.

Keywords GIS: Geographic Information System,RS: Remote sensing, ,IRR: Iraqi Republic Railways

Introduction

Railway is one of the important transport modes, which has a key role in the growing of economic development projects in a large number of countries in the world, and support their national economies in Iraq. Railways was the main transport mode before 1958 as a result of the lack of paved roads between cities, and limited number of cars used at that time. After construction of roads between the provinces exposed to intense competition, which led to a decline in the number of passengers, especially trains were used non comfort, low speeds units, where the passenger train between Baghdad and Basrah takes more than 15 hours.[1]

The representation of the data using the Geographic Information System (GIS) technique, Bassed on Arc GIS software .[19]. By using the Universal Transverse Mercator Coordinate (UTM) system provides coordinates on a world wide flat grid for easy computation, with Public-sector data, most of them are widely available where solid GIS spatial analysis techniques can produce a high-level analysis of rail infrastructure that is also locally relevant, minimizing cost and complexity[23][31],[36].The research focused on the railways in Iraq to improve their operating speed using modern techniques as (geomatic system) represented by(GIS, R.S, Satellites imges),[14],[15] to construct the digital updated database of Iraqi railways.Map(2) and make digital maps for their tracks with the preparation of a wide range database as(regular &irregular crossing , speeds, soil type, resistance, journey time, types of lines and the numbers of passengers and goods) to help decision makers and researchers to develop appropriate solutions of the transportation problems for the Iraqi railways, analysis, and added data[19],[31],[36].

The Study was looking for a expert-user application to map the entire network digitally and to manage it more effectively. This way, engineering and technical maintenance teams would be able to organise their work more efficiently.Where Existing Railway Lines in Iraqconsistof: 1-Baghdad-Basrah line,2-Baghdad – Mosul- Rabiha line,3- Baghdad -AL Qa'im - Akasht line,4- KirkukBaiji-Haditha line.

The Study Area

The Study area represented by the northern and southern railways line located from Al Alamiya station in Baghdad to Al Mosul in the North and Al Basrah in the South as shown in Fig (1).

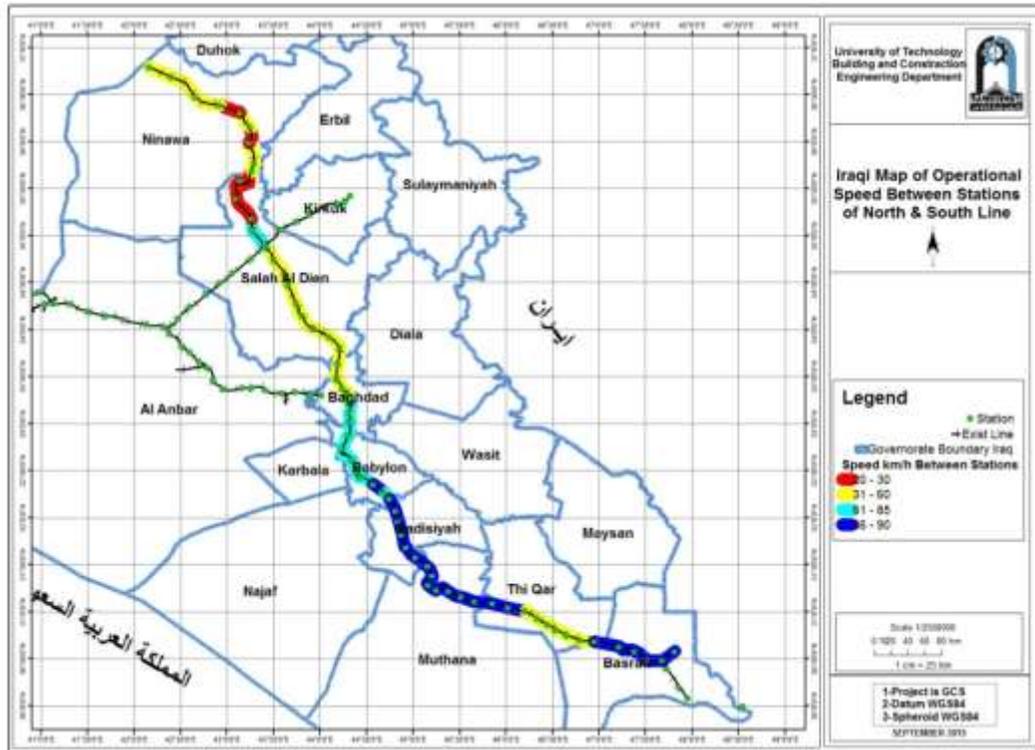


Figure (1):Operational speed of North and South line in Iraq.

Many Reasons of Low Operation Speeds of Iraqi Railways:Such as

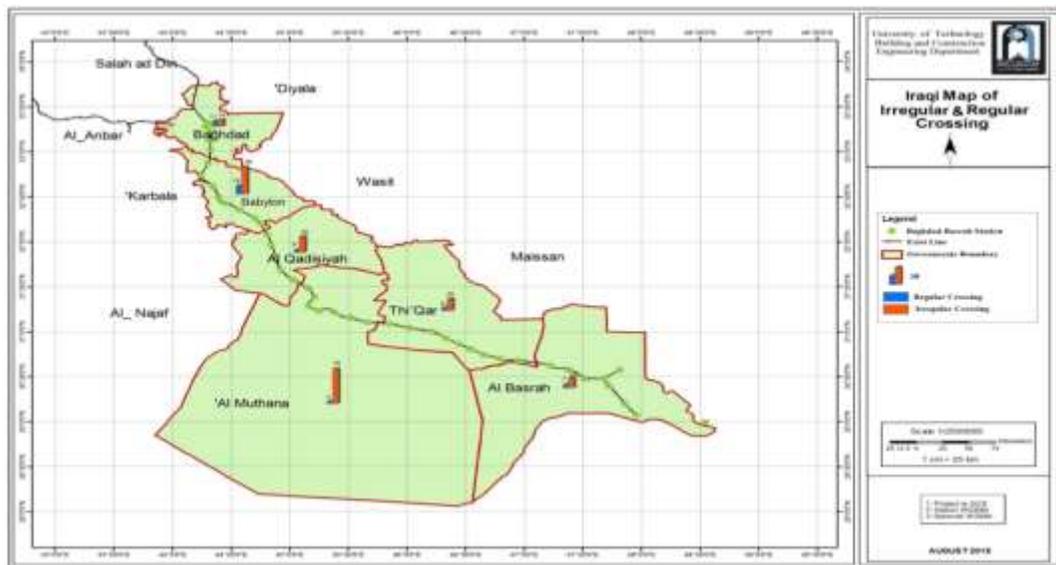
- 1- Irregular Crossing
- 2- Regular Crossing

Table (1): The passing time spent at every Governorate with stopping time for regular,irregular crossing, stations (minute).[2]

Governorate	Passing time (min)	Stopping time				Summation (min)
		Regular crossing (min)	Irregular crossing (min)	Stations (min)	Total time (min)	
Baghdad	74	22	28	48	98	172
Babylon	61	36	120	64	220	281
Qadisiyah	44	10	70	40	120	164
Al-Muthana	68	8	152	56	216	284
Thi'Qar	80	12	50	72	134	214
Basrah	55	14	44	64	122	177
summation	382	102	464	344	910	1292

Table (2): Illustrates numbers of irregular crossing for Baghdad –Mousl line.[12]

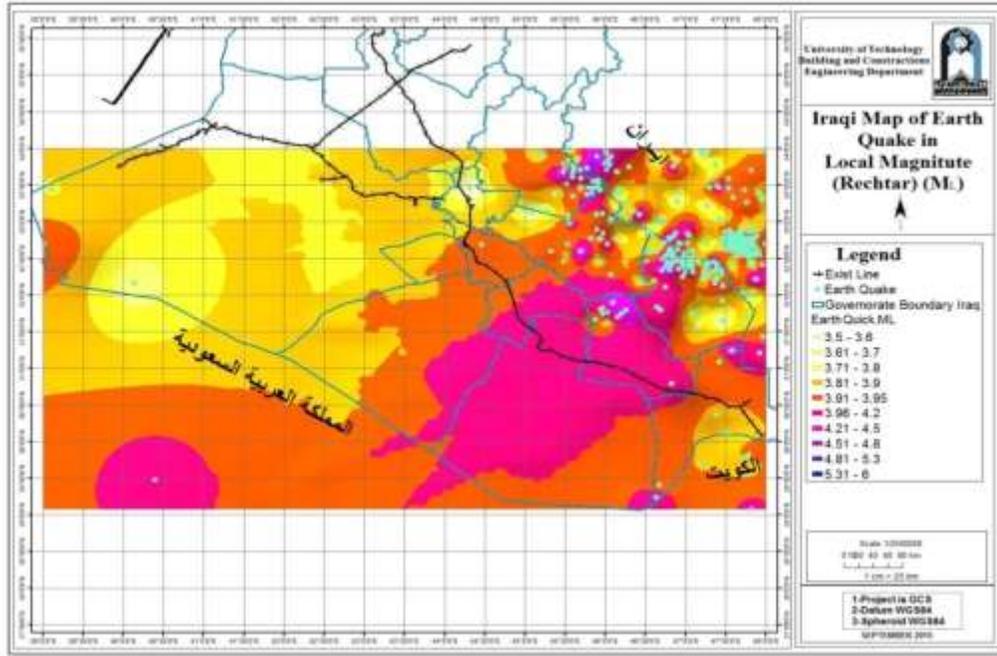
Rigon	Numbers of irregular crossing	Delay time (minute)
Baghdad	43	86
Baiji	48	96
Mousl	10	20
summation	101	202(3.36 hours)



Figure(2) Illustrates regular, irregular crossing in study area.

- 3- The Safe Fences

causes in the destruction of the bridges, the collapse of all facilities made from block with cracks and cracks cover the surface of the earth entirely, with a decline in the earth's surface, folds and twisting in the rail lines clearly.Fig.(4)shows Map of Seismic Event on Iraqi Governorates. [36], [27], [28].



Figure(4) Earthquake effected on Iraqi Governorates.

12- Air resistance: it takes when wind speed taken as zero. Mathematical calculaions indicate that air resistance is proportion directly with square of speed and increased with the decreased of weight of trains.Tables (3) and (4) show applications to Tuthill equations due to rolling and air resistance , [7],[16],[17].For (V) greater than(80) km/h and Davis equation For V up to (< or = 80km/h).

Table (3):Tuthill equations due to rolling and air resistance .ForV greater than 80 km/h[21]

$Ra+r = 0.9 + 0.011 V + 0.00088 V^2$ for $W = 20$ tons (1)
$Ra+r = 0.55 + 0.0057 V + 0.0008 V^2$ for $W = 30$ tons(2)
$Ra+r = 0.50 + 0.003 V + 0.00068 V^2$ for $W = 40$ tons (3)
$Ra+r = 0.27 + 0.0028 V + 0.0006 V^2$ for $W = 50$ tons (4)
$Ra+r = 0.20 + 0.0042 V + 0.00054 V^2$ for $W = 60$ tons (5)
$Ra+r = 0.26 + 0.0006 V + 0.00051 V^2$ for $W = 70$ tons (6)
$Ra+r = 0.24 + 0.0006 V + 0.0005 V^2$ for $W = 75$ tons (7)
where: W is the weight per vehicle in tons & V is the speed in km/h .

For compute resistance of rolling and air used (W.J.Davis equation) for speed equal to or less than 80km/h for vehicle and locomotive resistance.

$$R(a+r) = 0.6 + 13/w + AV + BCV/nw \tag{8}$$

Where: R(a+r)= resistance due to air and rolling, (0.6+13/w)= resistance due to rolling,track,axle

AV=flange resistance, BCV/nw= air resistance, V=speed (km/h)

w= weight of axle(tonne), n= number of axles, W = nw = weight of vehicle.

Table (4) Applications to Tuthill and Davis equations

Region	Operation (allowable speed) (km/h)	Air+ rolling resistance in (kg/ton)			
		Weight= 20 ton	Weight= 40 ton	Weight= 60 ton	Weight= 75 ton
Almarqazya-s r a (0-1.75)	20	4.35	2.735	2.6167	1.9813
S r a -mansoor (1.75-9)	20	4.35	2.735	2.6167	1.9813
Mansor-dora (9-17.25)	40	6.76	4.2	3.3467	3.0053
Dora-yosfya (17.25-31)	80	15.36	9.02	6.9067	6.0613
Yosfya-mahmodya (31-41.08)	80	15.36	9.02	6.9067	6.0613
Mahmodya alescandarya(41.08-59.04)	80	15.36	9.02	6.9067	6.0613
escandarya-msayab(59.04-72.95)	80	15.36	9.02	6.9067	6.0613
msayab -mhaweel (72.95-90.64)	85	8.193	5.668	4.4585	3.9035
mahaweel-hila (90.64-108.82)	75	14.0093	8.2797	6.3701	5.6058
hila -hadeed (108.82-120)	85	8.193	5.668	4.4585	3.9035
hadeed-hashmya (120-133.17)	85	8.193	5.668	4.4585	3.9035
hashmya -qujaan (133.17-148)	90	9.018	6.278	4.952	4.344
qujaan-sharefya (148-156.43)	85	8.193	5.668	4.4585	3.9035
sharyfya -sanya (156.43-170)	90	9.018	6.278	4.952	4.344
sanya- dewanya (170-184.67)	90	9.018	6.278	4.952	4.344
dewanya -nabee madyan (184.67-203)	90	9.018	6.278	4.952	4.344

13-Track profile: which consist of two types of resistances:a- due to gradient, With gradient the train has to pass resistance,[8].

a-Grade gradient in which always can be combined with curve Gradients any departure of the track from the level is known as resistance, they are used to provide a uniform rate of rise or fall to the tracks , reduce the cost of earth works, and reach the different stations at different elevations .Also, it has a major effect on the number trains, locomotive units with horse power for tract, the cargo on speed with time table on locomotive uses as well as the cost etc.

b-due to curves In order to avoid resistance beyond the allowable limits, the gradients are curves except transition curve are uniform nature, i.e. for any unit of length travelled round the curve, the same amount of change of direction is found.[30].In Iraq (R) equals to (1200 m) for main line,while at marshalling yard range between(400-500) m,but inside the stations(R>equals (250) m.[10].

15-Resistance Due to Starting and Accelerating

16-Rolling resistance

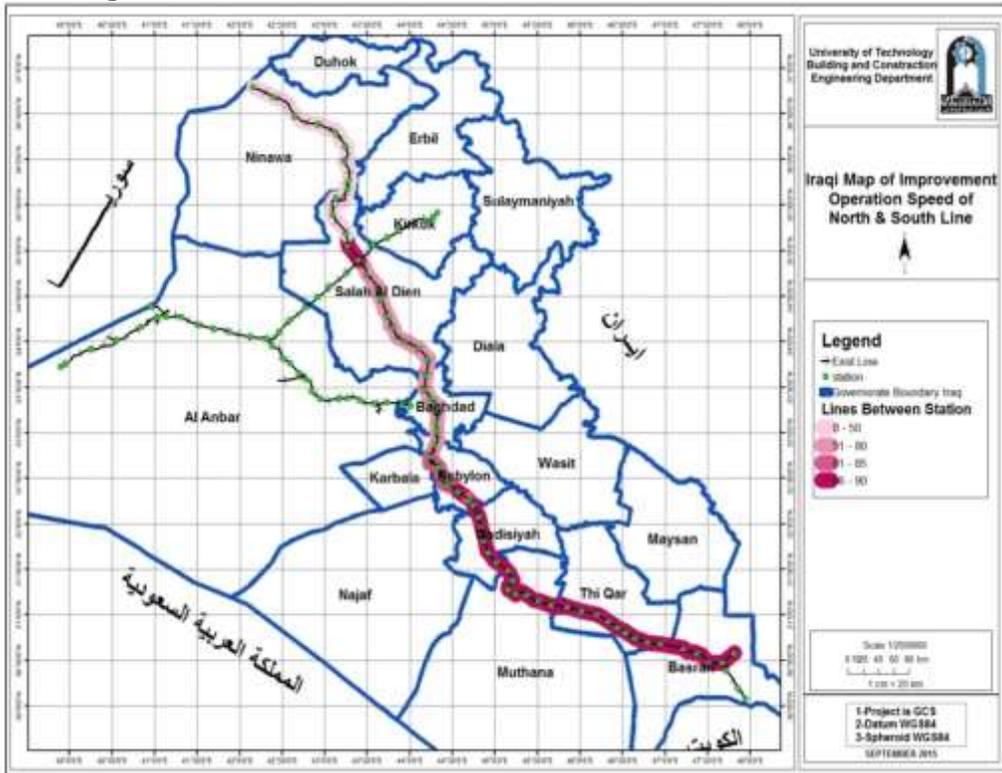


Figure (5): Improvement of operational speed of north and south line in Iraq.

Conclusions:

To increase the operational speed of the trains, through viewpoint of safety, economy, better riding qualities and efficiency operational speed can be developed. The study included constructed digital database for the first time about Iraqi railway nets were employed by Geomatics techniques (Arc GIS) software and prepare a suitable digital map which transferred into the GIS database, includes a huge database extraction from (GIS, Surveying), speeds, journey times, accidents, maintenance, numbers of passengers, and amount of frights, numbers of stations, location in (km length), numbers of lines inside stations, length between stations, coordinate of stations etc. that can be used by decision makers, researchers in the future for planning, design, prepare short and long-range strategies, reduction of accident, and evaluation performance of Iraqi railway nets. Journey time from Baghdad to Basrah on distance (551.84) km was, about (10) hours including total delay time (147.4) minutes and speed range between (20 – 90) km/h at (regular, irregular crossings, stopping at station, time of get in and out from station), due to these factors; land use, soil type, single line, no safe fences, bad signals and communication systems, old rolling stock, and low maintenance, that can be increased to range from (80-90) km/h as indicated in (Fig 6). [31],[33] by removing irregular crossings, using overpass for regular crossings, using good improvement for (signals and communication systems, the soil), maintenance to fences, reducing stopping time at stations, and laying another line (double line). Total journey time from Baghdad to Basrah can be reduce to (5.13) hours by increasing the operational speed at a percentage 23% (as in India railway which is nearly similar to the case in Iraq) so speed range between (98-110.7) km/h.

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