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道路安全审计在中国的应用
Road Safety Audit in China

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道路安全审计的定义
Definition of RSA

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- 英国公路与运输研究院（*IHT*）
  - 对新建道路项目和现有道路的改善和维护项目的事故风险和安全性能的正式审查。

    A formal procedure for assessing accident potential and safety performance in the provision of new road schemes, and schemes for the improvement and maintenance of existing roads.
- 澳大利亚（*AUSTROADS*）
  - 对规划的道路或交通工程、现有道路及任何与道路用户相关的项目的正式审查，由独立的、有资质的审查人员给出关于项目的潜在事故风险和安全性能方面的审查报告。

    A formal examination of a future road or traffic project, an existing road, or any project which interacts with road users, in which an independent, qualified examiner reports on the project’s potential for road crashes and safety performance.

道路安全审计的定义
Definition of RSA

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- 中国新疆自治区道路安全审计程序（*PRSA_XJ*）
  - 对现有或设计阶段的道路工程项目或交通工程项目、任何与道路用户有关的其他项目的道路安全的正式审查，由独立的、合格的审查者进行。

    A formal examination of road safety performance of existing highways (network) and any designed highway or traffic project that may change the relationship between highway user and road environments by independent and qualified auditor.

道路安全审计的目的
Objectives of RSA

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道路安全审计的主要目的是尽可能确保所有新建公路项目的安全。

The main aim of RSA is to *ensure that all new highway schemes operate as safely as practicable*.

具体目标如下 (*specific aims):*

- 使项目的事故风险性及事故严重性最小。

  To minimize the risk of accidents occurring on the scheme, and to minimize their severity.
- 使邻近道路的事故风险性最小，即避免在路网的其他部分造成事故。

  To minimize the risk of accidents occurring on adjacent roads, i.e. to avoid creating accidents elsewhere on the network.
- 承认公路设计中安全的重要性以满足所有道路用户的需要及可能的矛盾需求间的平衡。

  To recognize the importance of safety in highway design to meet the needs and perceptions of all types of road user; and to achieve a balance between needs where they may be in conflict.
- 降低方案的长期成本, 不安全的设计方案成本更高甚至在后期难以更改。

  To reduce the long term costs of a scheme, bearing in mind that unsafe designs may be expensive or even impossible to correct at a later stage.
- 提高在道路的规划、设计、施工和维护阶段安全设计的意识。

  To improve the awareness of safe design practices by all involved in the planning, design, construction and maintenance of roads.

道路安全审计程序
The RSA Process

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程序 Activity	职责 Responsibilities
选择审计人员 Select auditor	业主 Client
准备并提交背景资料 Background information	设计者 Designer
召开第一次讨论会 Start-up meeting	业主 / 设计者 / 审计人员 Client / Designer / auditor
室内评价 Review documents	审计人员 Auditor
现场勘查 Inspect site	审计人员 Auditor
撰写安全审计报告 Write report	审计人员 Auditor
召开评价结果讨论会 Completion meeting	业主 / 设计者 / 审计人员 Client / Designer / auditor
提交最终报告 Follow-up	业主和设计者 Client and Designer

道路安全审计的时间
When to audit…

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根据设计的阶段性，一般在五个不同的阶段实施道路安全审计，五个阶段分别如下：

five stages:

- 项目可行性研究阶段 (the feasibility stage)
- 初步设计阶段 (the draft Design stage)
- 施工图设计阶段 (the detailed Design stage)
- 开放交通前 (the pre-opening stage)
- 开放交通后和现有道路的安全审计 (an audit of an existing road)

中国实行道路安全审计的必要性
Necessity of Conducting RSA in China

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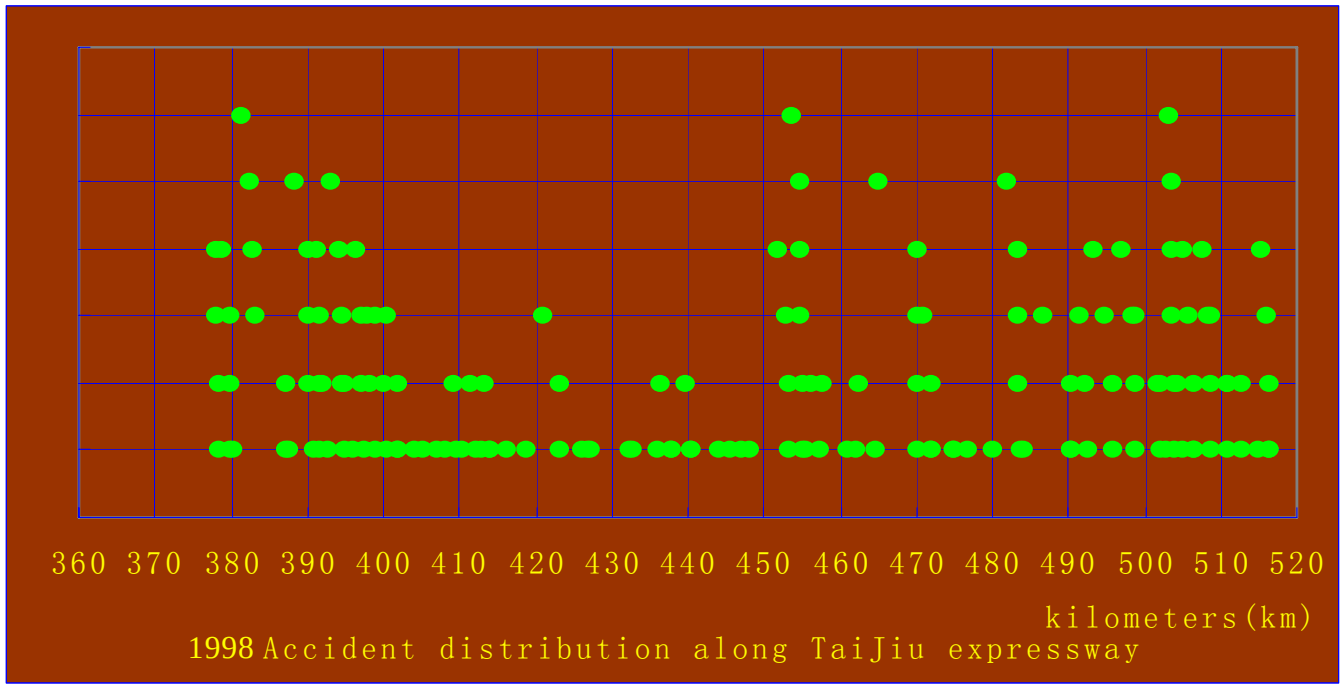
道路沿线事故的不均匀分布说明事故的产生不是随机的，而是与不安全的道路设计和运营管理有关。

The uneven accident distribution along expressways shows that the occurrence of accidents is relative to the unreasonable road design and management, etc.



中国实行道路安全审计的必要性
Necessity of Conducting RSA in China

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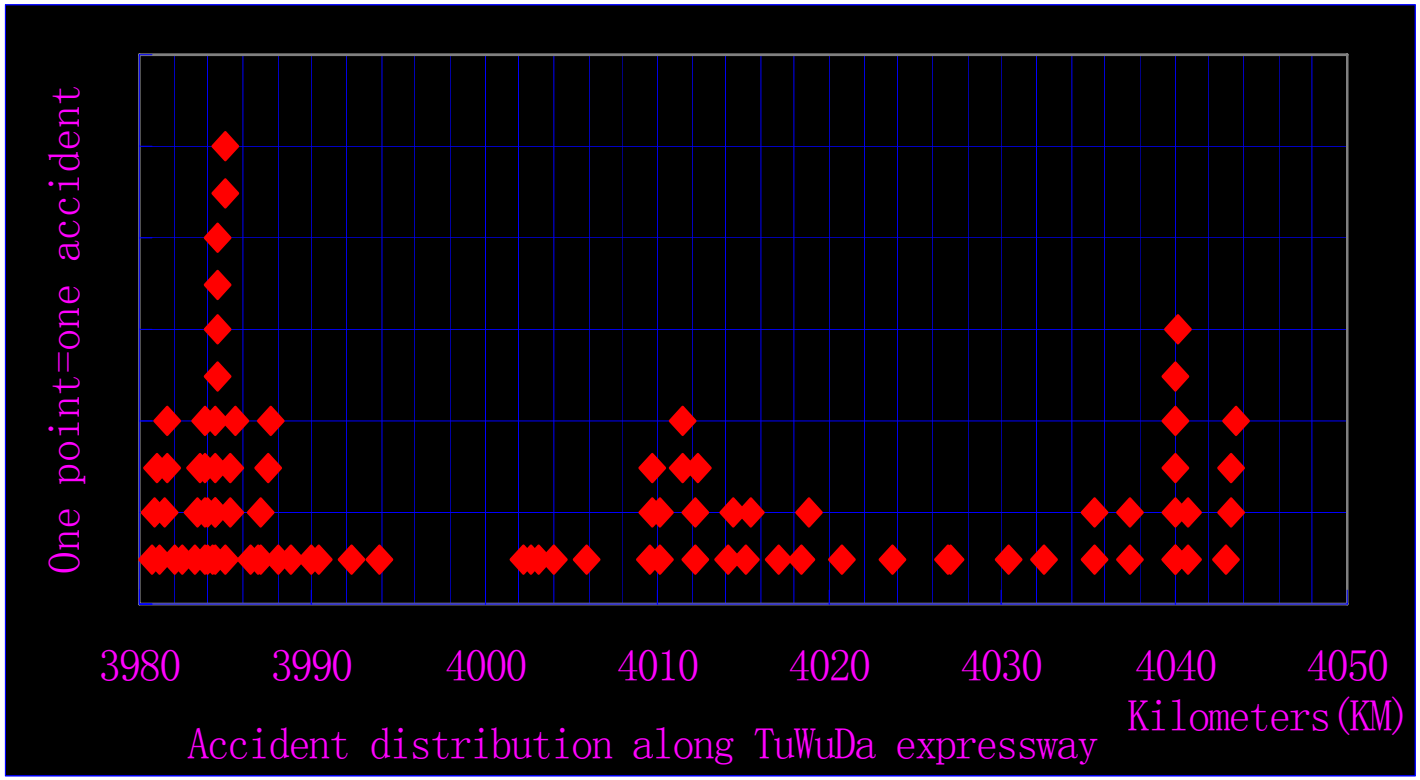
实例二

another example



中国实行道路安全审计的必要性
Necessity of Conducting RSA in China

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事故（多发段点）黑点情况

公路名称	观测路段的总事故数	鉴别出的黑点数	黑点处事故所占比例
城俞高速	1242	16	533/42.9
沈大高速	3191	35	
济青高速	1061	28	394/37.1
太旧高速	177	27	87/49.1
沪宁高速	245	10	78/31.8
吐乌大高速段	164	13	
104 国道（泰安段）	287	22	185/64.4
烟青一级公路	323	27	193/59.8

中国实行道路安全审计的必要性
Necessity of Conducting RSA in China

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Statistic of Accidents on blackspots

Highway name	Total accident number	Number of blackspots	Accidents on blackspots /proportion(%)
Chengyu freeway	1242	16	533/42.9
Shengda freeway	3191	35	
Jiqing freeway	1061	28	394/37.1
Taijiu freeway	177	27	87/49.1
Huning freeway (Wuxi section)	245	10	78/31.8
Tuwuda freeway	164	13	
national highway No. 104	287	22	185/64.4
Yanqing highway	323	27	193/59.8

中国实行道路安全审计的必要性
Necessity of Conducting RSA in China

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目前，中国的道路设计和运营管理中存在的安全问题。（实例）

The safety problems during the road design and management in China.

(examples)

路线几何设计实例
Examples for geometric design

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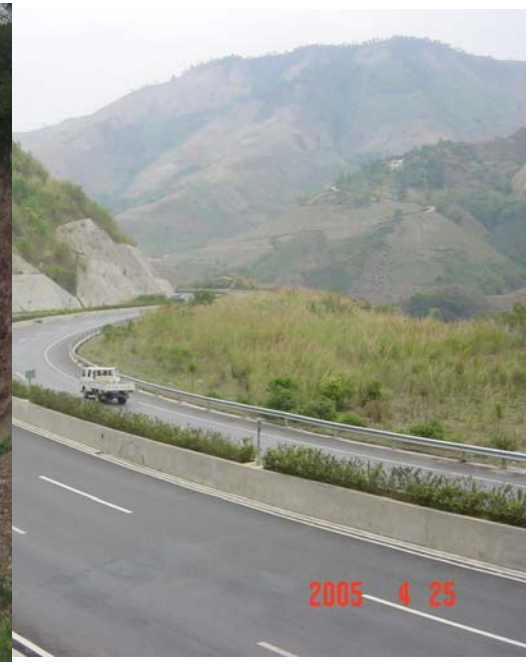
S型曲线对行车具有潜在的危险性，且在第二个转弯处视距不足。此路段3年内发生10起事故。

S-style curve with small radius is a potential hazard to vehicles. And the sight distance is not adequate at the second turning. Ten accidents occurred in this section during three years.



道路安全审计的实施对比
Comparison of Conducting RSA

	PRSA_XJ	Austroads	IHT
组织方式 **Ways of Organization**	• 方法 1: 自治区道路安全领导小组有权要求业主进行道路安全审计，选择第一类道路安全审计队伍，审计报告和书面答复交予领导小组和业主。 Way 1: The LGXJRS order the clients to conduct RSA. Audit by RSA team of type one. RSA report and written response should be submitted to the LGXJRS and the client. • 方法 2: 自治区道路安全领导小组对业主有进行道路安全审计的要求，选择第一类或第二类道路安全审计队伍，审计报告和书面答复交予业主，抄送领导小组。. Way 2: The LGXJRS require the clients to conduct RSA. Audit by RSA team of type one or type two. RSA report and written response should be submitted to the client and copied to the LGXJRS.	• 由专业的审计人员或审计小组进行审计 Audit by a specialist auditor or audit team • 由其他道路设计者进行审计 Audit by other road designers • 由原道路设计单位自己进行审计 Audit within the original design team	• 专业评价与安全证书 Specialist advice and audit • 专业评价和独立的项目管理者 Specialist advice and independent project manager • 专业评价和设计者 Specialist advice and designer • 设计单位与独立的顾问 Design team and independent consultant • 由第二设计单位进行审计 Audit by other design team • 由原设计单位自己审计 Audit by the original design team

道路安全审计的实施对比（续）
Comparison of Conducting RSA (cont.)

组织方式(续) **Ways of Organization（cont.）**	• 方法 3: 业主自行决定是否进行道路安全审计并选择审计者，审计报告交予业主，可抄送领导小组。业主应给予书面答复。 Way 3: The client himself decided to do RSA or not. RSA report and written response should be submitted to the client and copied to the LGXJRS.		
审计时间 **When to Audit**	五个阶段 (five stages)： • 项目可行性研究阶段 feasibility stage • 初步设计阶段 preliminary stage • 施工图设计阶段 detailed stage • 开放交通之前 pre-opening stage • 开放交通之后和现有公路的道路安全审计 post-opening stage and existing highway road safety audit	五个阶段 (five stages)： • 项目可行性研究阶段 the feasibility stage • 初步设计阶段 the draft Design stage • 详细设计阶段 the detailed Design stage • 开放交通前 the pre-opening stage • 现有道路的安全审计 an audit of an existing road	四个阶段 (four stage)： • 项目可行性研究阶段 feasibility stage • 初步设计阶段 preliminary stage • 详细设计阶段 detailed stage • 开放交通前 pre-opening stage

道路安全审计的实施对比（续）
Comparison of Conducting RSA (cont.)

需要进行审计的项目 **What Projects to be Audited**	• 新建公路 new highway development projects • 旧路改造 highway rehabilitation projects • 交通控制系统变更或变更交通设施 traffic control system and traffic measures • 公路附近的产业开发 estate development along highways	• 新建高速公路 new freeways • 主要的道路 Major divided roads • 重建和改线项目 Reconstruction and realignment projects • 交叉口项目 Intersection projects • 行人和自行车通道 pedestrian / bicycle route • 信号升级 signal upgrading • 发展项目 development proposals • 地方的交通管理项目 local area traffic management schemes • 减少事故的项目 accident reduction schemes	• 主要的道路项目 major highway schemes • 道路的改善项目 minor improvements • 交通管理项目 traffic management schemes • 发展项目 development schemes • 维护工作 maintenance works

道路安全审计的实施对比（续）
Comparison of Conducting RSA (cont.)

相关人员的职责分工与合作关系 **Roles of Parties**	• 业主: 提供基础条件，决策者，有责任保证道路安全审计的实施。 client: Provide the basic conditions of the project, make decision and ensure RSA is conducted. • 设计者: 有责任依据业主的决策，保证必要的措施设计的修改。 designer: Ensure the necessary measure are agree to on the basis of the recommendations from the auditor and the decisions made by the client. • 审计人员: 严格审阅设计和现场勘察，阐明所有可能的安全问题及原因。 auditor: Review the project, indicate all the road safety problems and describe the reasons.	• 业主/设计者: 选择审计人员，提供项目资料，召开审计动员会议，决定行动，提交反馈意见. client / designer: Selects auditor, provides documents, holds startup meeting, decides action, documents decisions. • 审计人员: 审阅项目资料，现场勘查（白天和黑夜），按要求重复上诉步骤，撰写审计报告， 召开审计结果会议。. auditor: Review documents, inspects site (day & night), repeats steps as required, writes audit report, holds completion meeting.	• 业主: 委托审计。 client: Commission audits. • 项目管理者和设计者: 对每个项目发动实行安全审计。 project manager / design engineer: Initiate the safety audit process for each scheme • 审计人员: 只针对项目的安全问题进行审查和提出建议。 auditor: Comment only on the safety implications of schemes and provide recommendations.

道路安全审计的实施对比（续）
Comparison of Conducting RSA (cont.)

安全问题的严重级别 **Serious Grade of Safety Problem**	四个等级（ four grades） • 特别严重的 Very serious • 严重的 Serious • 一般的 Normally serious • 轻微的 (现有公路) Not serious (only for existing highways)		

审计清单
Checklist

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- 审计清单的作用(Purpose of Checklists)
  - 审计清单是对于审计者非常有价值的辅助工具，以免重要的安全问题被遗漏。

    Checklists is a valuable aid to audit so as to check that no important safety aspects are being overlooked.
- 审计清单实例（交叉口）

  Examples for Intersection Checklists
  - 冲突点和冲突范围是否可以减少以利道路安全?

    Are the length, width and other alignment characteristic of merging and diverging ways adequate to all of the vehicles?
  - 合流、分流渐变段的长度、宽度等几何线形是否适合于所有的车辆?

    Can the horizontal and vertical alignment of entry/exit ways of grade intersections satisfy the requirements to visibility?
  - ……

道路安全审计的依据
Basis of RSA

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- 相关设计规范

  Relative specification
- 道路事故历史数据

  Road accident history data
- 案例

  RSA or Accident prevention cases
- 工程师的经验

  Experience of Engineers
- 有关道路安全工程方面的理论：汽车驾驶心理学、道路交通流理论、交通法规和交通管理

  Relative road safety principle, drive psychology, road and traffic design technology, traffic regulation and management, etc.
- 其它

  Others

动态三维透视图
Dynamic three-dimension perspective drawing

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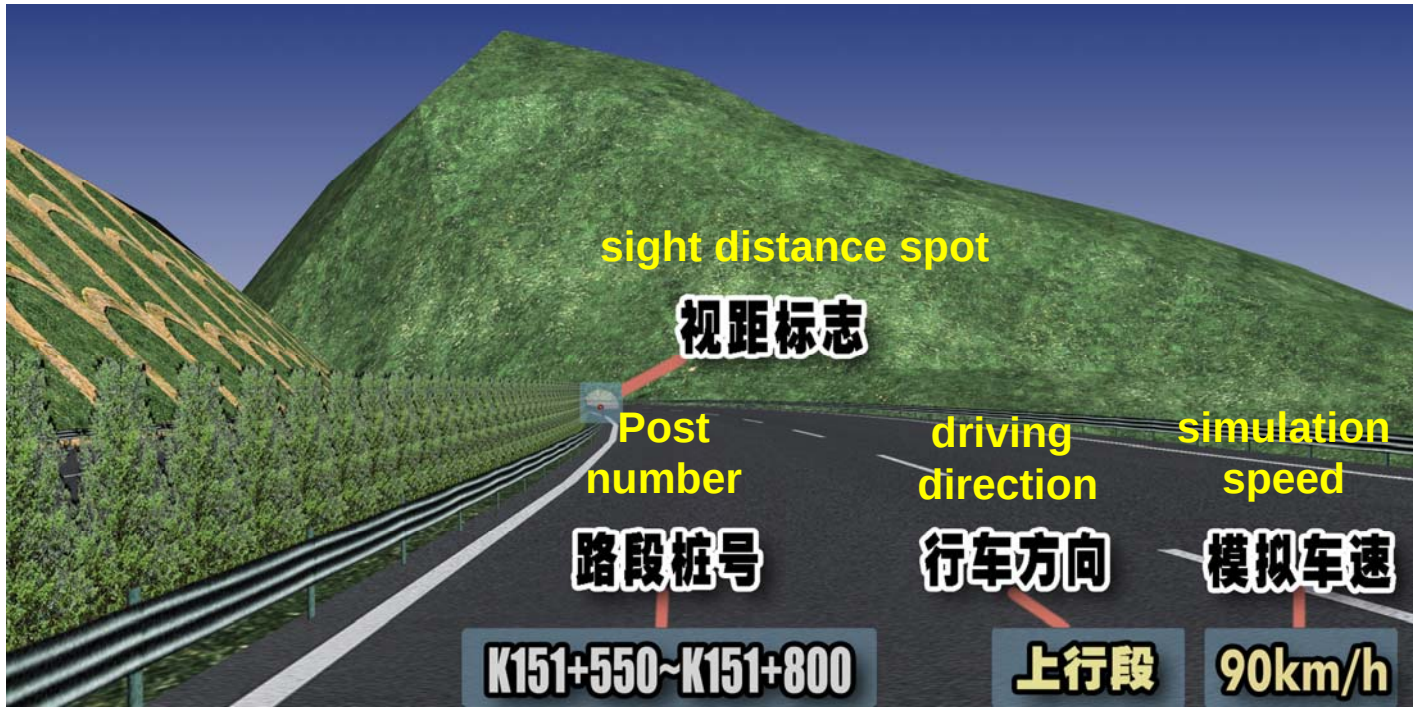
应用动态三维透视图检查视距。

Checking the sight distance by applying dynamic three-dimension perspective drawing.

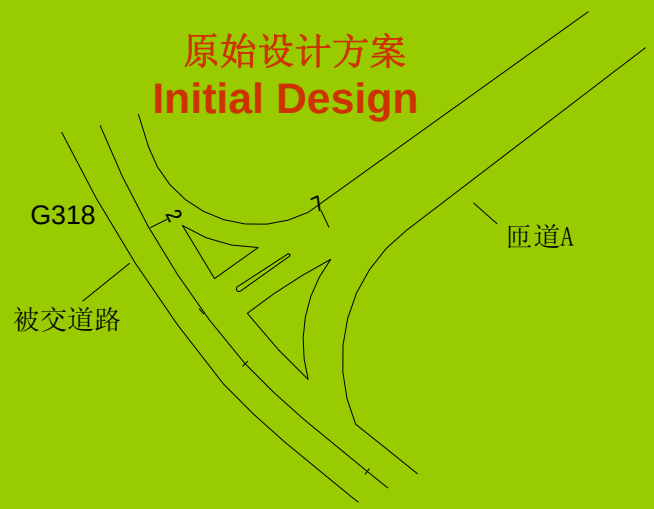


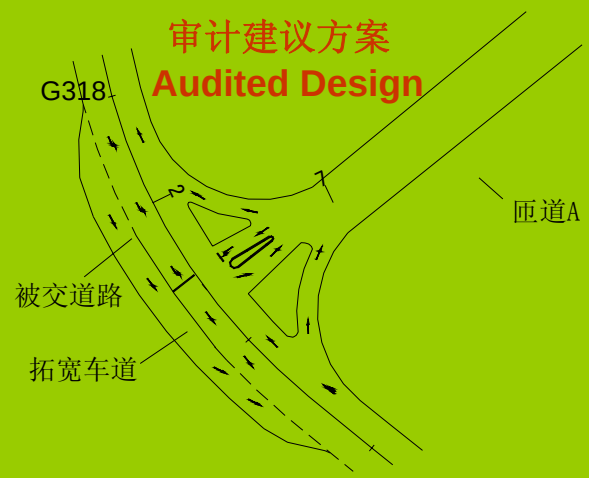
案例分析一
Case Studies

P I A R C

匝道**A**与被交叉道路**G318**之间的平交设计，设计方案中采用了渠化岛型式。

The grade intersection of ramp A and highway G318 adopt the channelization island in the initial design.





建议Ⅰ**:** 进一步强化该平面交叉口的渠化交通。

Recommendation Ⅰ**:** *Strengthen the channelization at the grade intersection***.**

建议Ⅱ**:** 在被交道路上拓宽一个车道。

Recommendation Ⅱ**:** *Widen a lane at the grade intersection in G318.*

案例分析二
Case Studies

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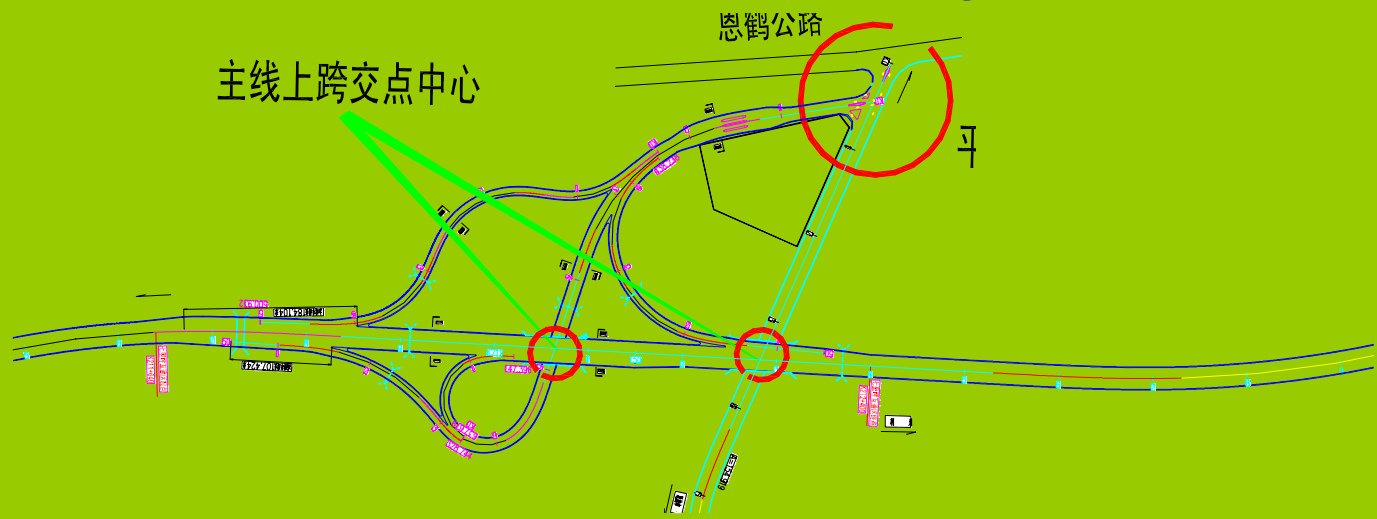
主线上跨A匝道，桥墩易被失控车辆冲撞且影响视距。

The ramps cross the normal line above. The piers are dangers for uncontrollable vehicles and influence the sight distance.



建议 Ⅰ: 调整布局，避免在中间带上设置桥墩以保证视距。

Recommendation Ⅰ: *Adjust the layout and avoid setting piers in the middle of the road to ensure the sight distance.*

建议 Ⅱ: 在桥墩周围设置防撞栏杆。

Recommendation Ⅱ: *Set the guard fence around the piers.*

案例分析三
Case Studies

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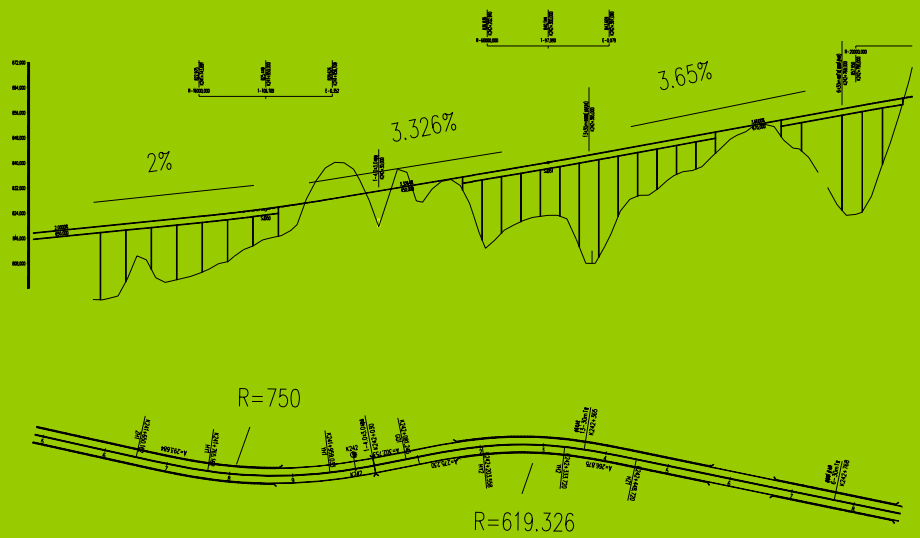
小半径S型曲线位于坡度较大的桥梁上，这种组合对安全行车不利，尤其是对下坡车辆可能存在一定的安全隐患。

The combination of horizontal S-style curve and great gradient is not appropriate.



建议 Ⅰ：放缓桥梁纵坡同时放大平曲线半径。

Recommendation Ⅰ: *Reduce the vertical slope and increase the radii of horizontal curves.*

建议 Ⅱ：条件受限情况下采用交通工程措施。

Recommendation Ⅱ: *adopt traffic engineering measures.*

案例分析四
Case Studies

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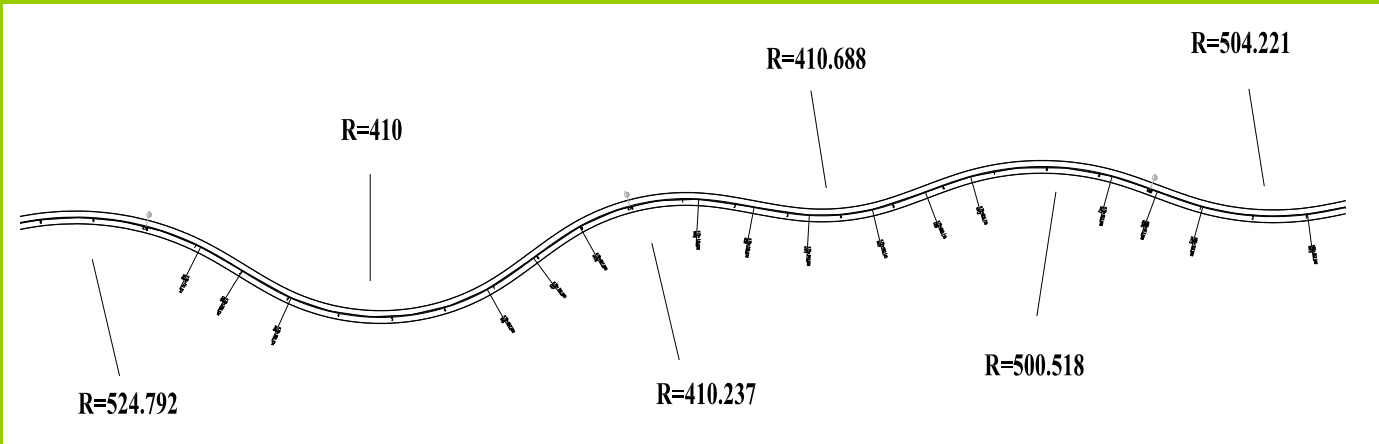
连续的**S**型曲线位于较大的纵坡上，且曲线半径较小，对安全行车不利。

The combination of continuous S-style curve with small radii and great gradient leads to serious safety problems.



建议 Ⅰ: 在该路段前后增设临时停车区。

Recommendation Ⅰ: *set temporary park before and after this section.*

建议 Ⅱ: 采用限速、预告等交通工程措施。

Recommendation Ⅱ: *adopt traffic engineering measures such as speed limit and warning.*

案例分析五
Case Studies

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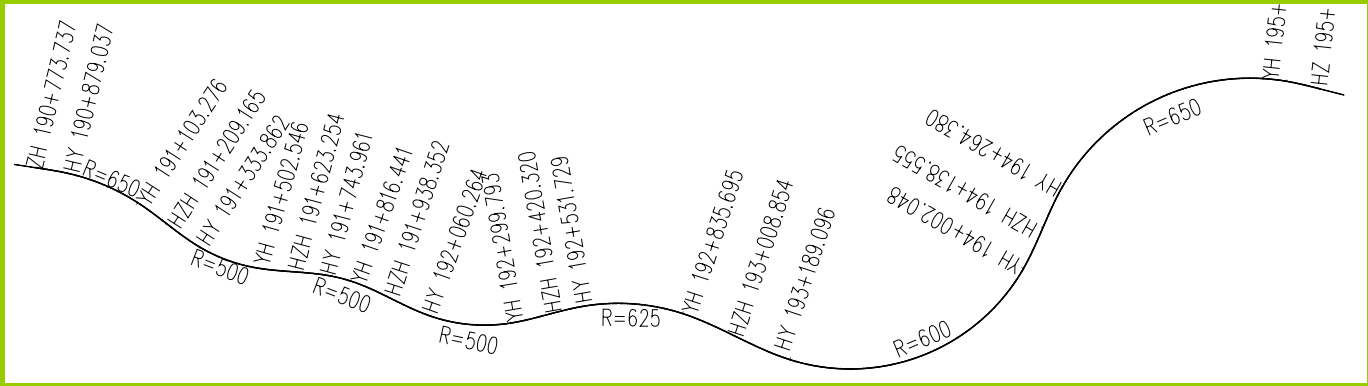
该路段**4.40km**长度范围内连续出现**7**个平曲线，且半径均偏小，另外根据透视图检查结果，当模拟车速采用**90km/h**，视距明显不足。

Seven small-radius curves exist continuously within 4.40km, and the sight distance is not adequate according to the result of Dynamic Three-dimension Perspective Drawing.



建议 Ⅰ：在该路段前后增设避险车道。

Recommendation Ⅰ: *set danger-avoiding lane before and after this section.*

建议 Ⅱ：采用限速、预告等交通工程措施。

Recommendation Ⅱ: *adopt traffic engineering measures such as speed limit and warning.*

谢谢！

Thank you !

email: